ROADMASTERS' CONVENTION NUMBER

Railway Engineering and Maintenance

"STEAD"
TRUE TEMPER
RAIL ANCHOR
Initial and Application
Costs Low

THE AMERICAN FORK & HOE COMPANY
General Offices: Cleveland, O. *Factory:* North Girard, Pa.
District Offices
Whitehall Building, New York City - Daily News Plaza, Chicago, Ill.
Representatives at
Boston, Denver, Detroit, Louisville, Minneapolis, St. Louis and San Francisco
Foreign Representatives
Wonham, Inc., 44 Whitehall St., New York City, and 68-72 Windsor House, Victoria St., London, S.W.-1

No crossing is safer than this—

bolts held tight by HY-CROME

TIGHT bolts on crossings are imperative, and the most economical means of keeping track bolts tight is used when HY-CROME is applied on every track bolt at every rail joint.

Non-fatiguing, unchanged in its great reactive energy and wide reactive range by time or traffic or climatic conditions, HY-CROME affords the most permanent rail joint rigidity at the lowest cost per mile.

For crossings, there is an extra heavy HY-CROME spring washer in use by many Class 1 roads that differs from HY-CROME for main line specifications only in that it has a greater cross-section area. Electric alloy steel, careful heat treatment, exacting manufacturing methods—these are the same. Make the HY-CROME TRACK TEST now—on crossings and main line track—at our expense.

THE
RELIANCE MANUFACTURING CO.
MASSILLON, OHIO
Engineering Materials, Ltd., McGill Bldg.
Montreal, Quebec, Canada

HY-CROME
Reg. U. S. Pat. Office

RAILWAY ENGINEERING AND MAINTENANCE
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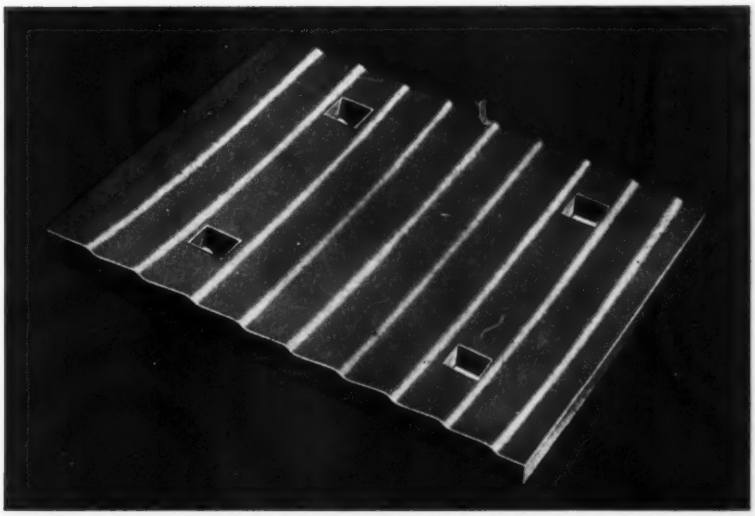
Using Treated Cross Ties *is not enough*



For Utmost Economy They Must Be Plated Properly

Space No. 99 at the Convention

ALL the care and money spent for preservative treatment is lost if tie plates are used which cut into the treated layer of the timber.

You DO get proper protection from Lundie Tie Plates. Millions in service prove it. There are no sharp projections—instead the bottom has a series of rounded steps which hold track to gauge without cutting a single fibre of the tie.

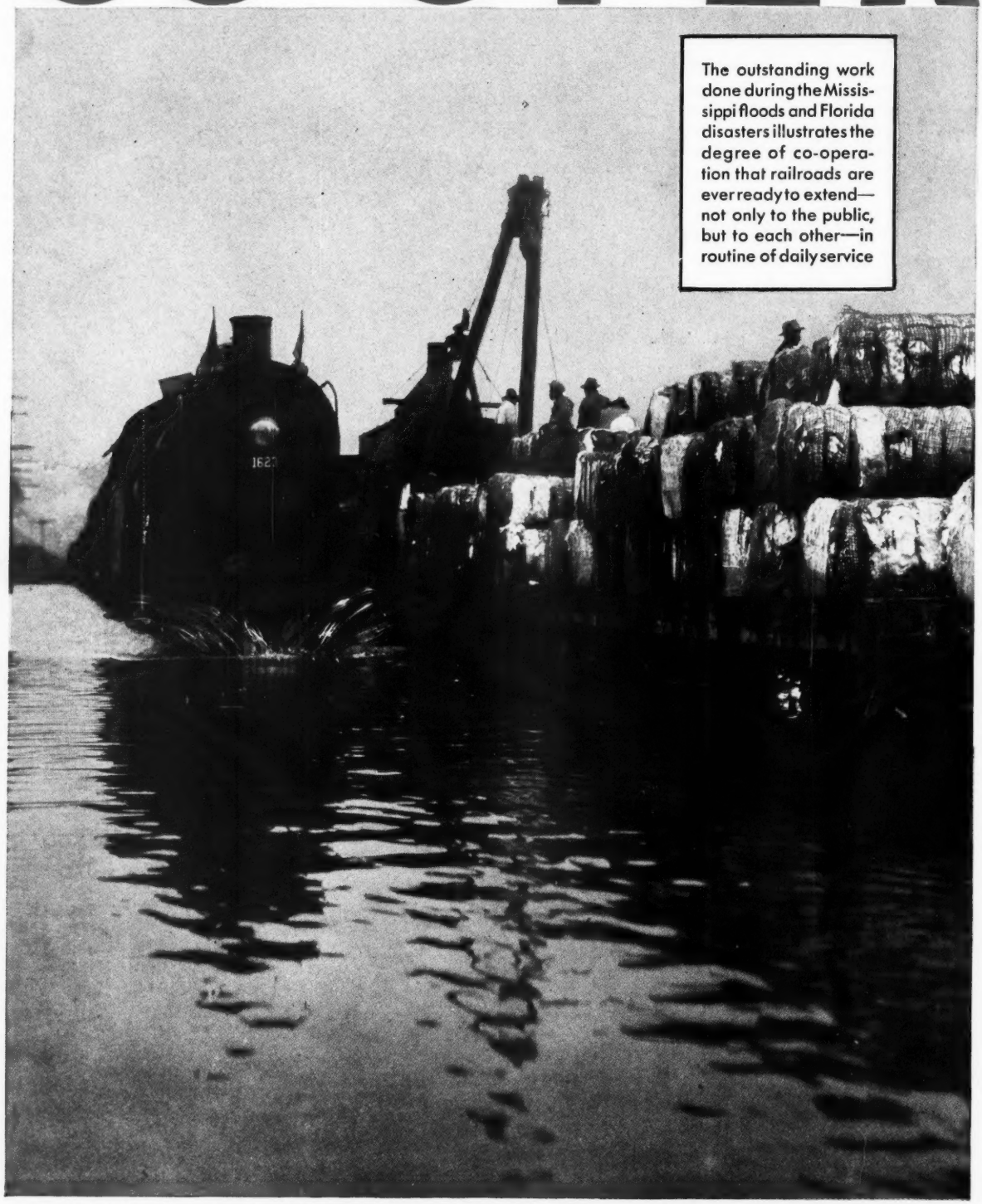
Lundie Tie Plates guard against tie depreciation. Their use effects big economies, longer tie life and fewer renewals. They assure full return from treated cross ties.

The Lundie Engineering Corporation

285 Madison Avenue, New York
59 East Van Buren Street, Chicago

LUNDIE TIE PLATE

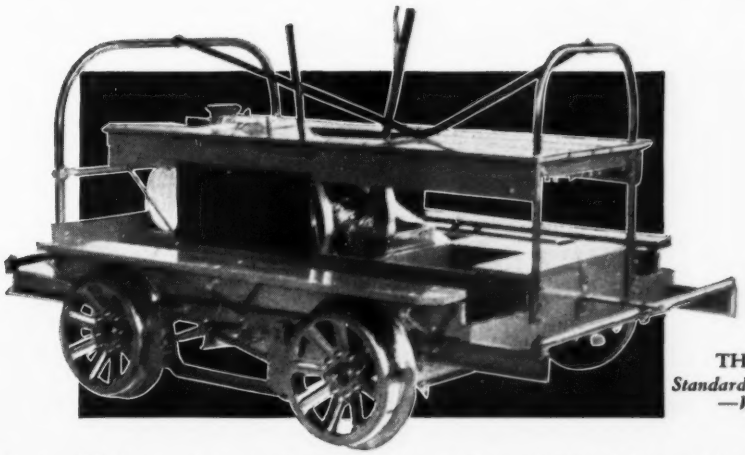
CO-OPER



The outstanding work done during the Mississippi floods and Florida disasters illustrates the degree of co-operation that railroads are ever ready to extend—not only to the public, but to each other—in routine of daily service

· THE · RAILROAD · WORLD ·

ATION



THE FAIRMONT S2
Standard Section Car—Two Types
—Wood or Steel Frame

The spirit of unselfish service motivating the Railroad World was the inspiration that brought world-wide leadership to the Fairmont organization.

This is seen in the Fairmont objective—to sell not equipment, but *lowest overall cost* of service. The fact that over half the motor cars now in use are Fairmont products is undeniable evidence that this objective has been consistently attained and the Railroad World appreciates the spirit behind it.

When you transact business with Fairmont, you deal with specialists who are ready with a *lowest cost* solution to every problem of motor cars on maintenance work. Representatives everywhere to serve you.

FAIRMONT RAILWAY MOTORS, INC.

FAIRMONT, MINNESOTA, U. S. A.

General Sales Offices: 1356 Railway Exchange Bldg., CHICAGO

District Sales Offices: New York City Washington, D. C. St. Louis San Francisco New Orleans

FAIRMONT RAILWAY MOTORS, Ltd., Toronto, Canada *Foreign Representative:* BALDWIN LOCOMOTIVE WORKS

Manufacturers of section motor cars, inspection motor cars, gang and power cars, weed burners, ballast discers, ball and roller bearing engines, push cars and trailers, roller axle bearings, wheels, axles and safety appliances

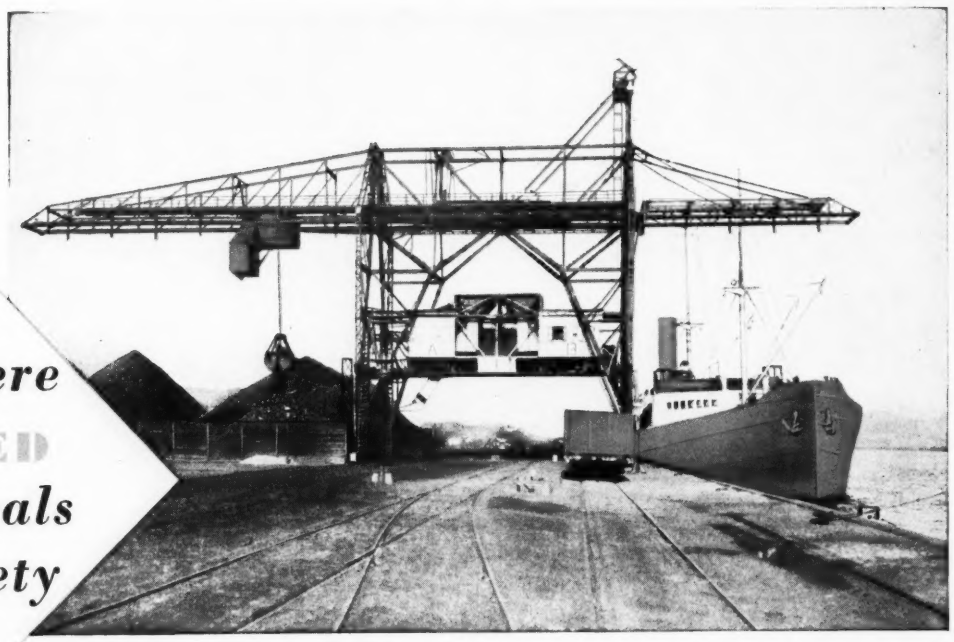
Fairmont Mudge

Performance on the Job Counts

· KNOWS · FAIRMONT ·

A *guard that says...*

Keep Out! *Corrosion*



where RED *signals safety*

RED LEAD *Safeguards Metal!*

THE blue-coated officer on his beat...the grim, gray dreadnaught of the deep...both are guardians of property. .both are symbols of protection.

In the same class, you can also place pure red lead... for it is the guardian of metal structures. It keeps out corrosion, the destructive agent which stealthily attacks unguarded metal structures.

NATIONAL LEAD COMPANY

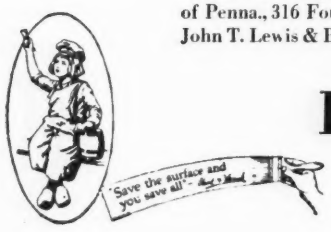
New York, 111 Broadway; Buffalo, 116 Oak Street; Chicago, 900 West 18th Street; Cincinnati, 659 Freeman Avenue; Cleveland, 820 West Superior Avenue; St. Louis, 722 Chestnut Street; San Francisco, 2240-24th Street; Boston, National-Boston Lead Co., 800 Albany Street; Pittsburgh, National Lead & Oil Co. of Penna., 316 Fourth Avenue; Philadelphia, John T. Lewis & Bros. Co., Widener Building.

Leading authorities on the subject know that red lead safeguards metal by sealing out corrosion...know that it keeps out air and moisture which foster corrosion.

Dutch Boy red lead is accepted as standard by leading engineers and metal maintenance authorities. Pure, fine and highly oxidized, it gives a degree of protection available with no other paint. Red signals safety... when the red is red lead.

Dutch Boy Red Lead is available in two forms, paste and liquid. The liquid (ready for the brush) is supplied in six colors...natural orange-red, two shades each of green and brown—and black. The paste comes to you as orange-red but it is easily shaded to dark colors.

Your request will quickly bring you the booklet, "Structural Metal Painting" and you are also invited to consult our Department of Technical Paint Service. In either case, address the nearest branch.



DUTCH BOY RED LEAD

DITCHING *for the* Erie . .

THE Erie R. R. keeps this Northwest constantly at work cleaning out old creek bottoms, digging new ditch along the right-of-way or lead-off ditch from water holes.

When it has completed one job they load it on a standard flat car without dismantling, run it to the next offending stream and it's busy again.

A Northwest goes anywhere and can carry several days fuel with it. It will build out shoulders, handle fill for elevating grade, drive piles, handle rail and do a hundred other jobs along the line. That's why 14 railways are using them.

Let us show you motion pictures of Northwests on railway work. Let us tell you what Northwests are doing for some of the country's greatest systems.

NORTHWEST ENGINEERING CO.

The world's largest exclusive builders of gasoline, oil burning and electric powered shovels, cranes and draglines

1713 Steger Bldg., 28 E. Jackson Blvd.
Chicago, Illinois
U. S. A.

The Northwest R. R. Special brings features no other machine can offer. The tapered caband rotating control assure safety to traffic. The patented steering method takes it where other machines can't travel. Scientific design assures greater capacity per unit of weight and cost. Crawler design permits crossing rail without jamming treads between the rollers.

RE&M 10-Gray

NORTHWEST

MAGOR

Great Strength - to "Carry On"

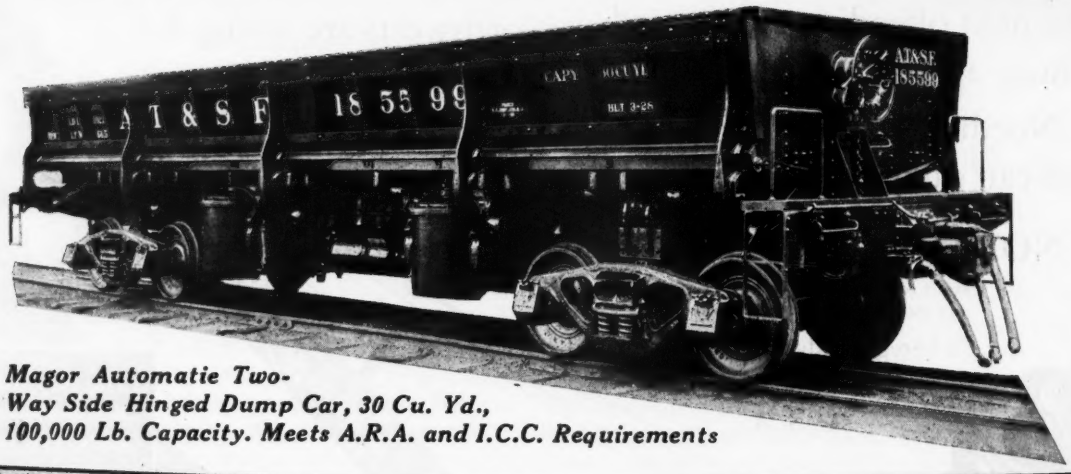
The Magor underframe has a center sill of fish belly construction—friction draft gear, A.R.A. type D couplers with 6 inch by 8 inch shanks. The trucks have U-section integral box type side frames. A.R.A. Standards are followed throughout.

The Backbone of the MAGOR AUTOMATIC AIR DUMP CARS

Strong Support – the entire length

The car body bed which has proved so successful in withstanding the impacts of loading and unloading is made up of a 12 inch 45 lb. rolled steel I-beam center sill—two 6 inch 22.8 lb. rolled steel Z-bar side sills and transverse channels so spaced that the span between floor supports at no place exceeds 12 inches.

The Bed of the Body of the MAGOR AUTOMATIC AIR DUMP CARS



Magor Automatic Two-Way Side Hinged Dump Car, 30 Cu. Yd., 100,000 Lb. Capacity. Meets A.R.A. and I.C.C. Requirements

Free Floating Door –

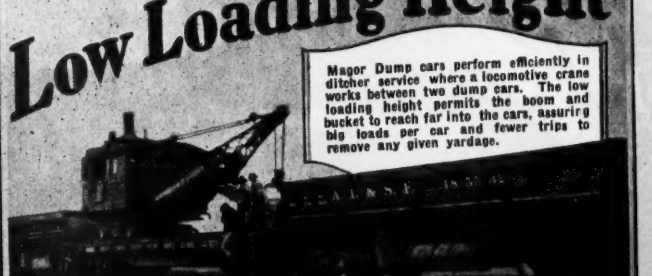
MAGOR AUTOMATIC AIR DUMP CARS

PREVENTS DAMAGE

The illustration shows what takes place when the MAGOR car is dumped under conditions preventing the full opening of the door. Such instances are not infrequent but with the MAGOR full floating door no damage to either door or car results, the door merely resting on the obstruction while the body continues its movement to the full dump position. Under normal conditions, when the body is in full dump position the door lies parallel with the car floor serving to discharge the load clear of the ballast line.

Low Loading Height

Magor Dump cars perform efficiently in ditcher service where a locomotive crane works between two dump cars. The low loading height permits the boom and bucket to reach far into the cars, assuring big loads per car and fewer trips to remove any given yardage.



MAGOR AUTOMATIC AIR DUMP CARS

AUTOMATIC AIR DUMP CARS

RUGGED-Throughout
In service Magor Dump Cars have thoroughly demonstrated the value of their exceptionally sturdy construction by giving extra years of trouble-free operation necessary for safe, economical and low maintenance dump car service. Magor Cars have the stamina to stand up under the severe punishment of loading and unloading. Capacity loads of big rocks are handled safely and efficiently.
MAGOR
AUTOMATIC AIR DUMP
CARS

Selective Dumping
Quick dumping to either side is another feature incorporated in the design of Magor Air Dump Cars.
A simple directional valve operative from either side of car controls and clearly indicates the direction of dump.
The special valve mechanism permits the dumping of an entire train, a single car or any number of cars irrespective of their location in the train.
MAGOR
AUTOMATIC AIR DUMP
CARS

When You Select a Dump Car Make Sure It Has All of These Features

YOU need them all for utmost serviceability, safety, efficiency and low maintenance costs.

The surplus strength in Magor Cars is insurance against failure and rapid depreciation in most severe service. It enables them to stand the hard knocks of loading and unloading and gives added years of dependable service with minimum upkeep cost.

The "Free Floating Door" and "Stability on Track" are safety features which protect against loss of property and even life.

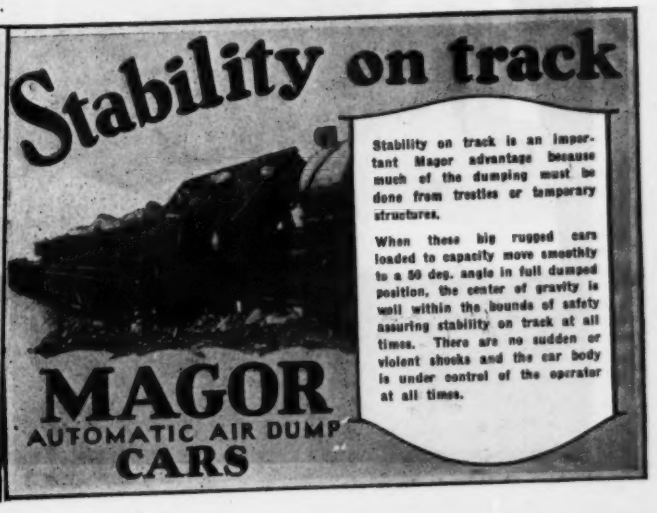
"Low Loading Height," "Selective Dumping" and "Over 50° Angle in full dump Position" are big time and labor saving features which assure efficient and economical operation.

For greatest return on your dump car investment you need all these features.—Specify Magor.

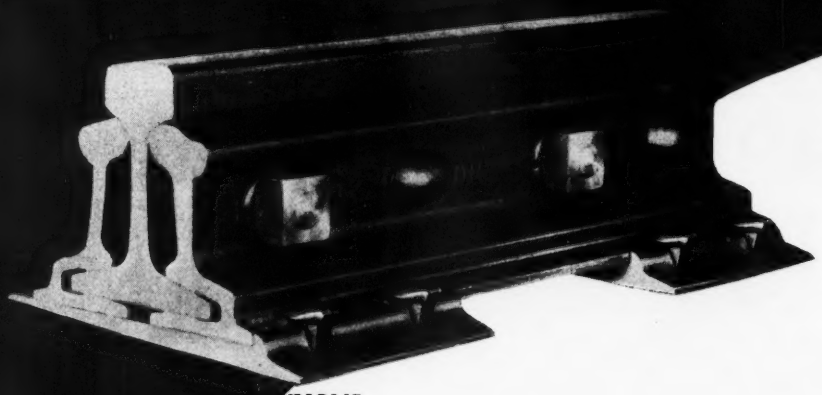
MAGOR CAR CORPORATION

50 Church Street New York

Over 50° Angle in full Dump position
ASSURES COMPLETE DISCHARGE OF LOAD
Air operated cylinders located on each side of the car permit dumping to right or left at will. The floor of the car attains an angle of over 50 deg. assuring complete discharge and the down turned door "chutes" the load clear of track ballast.
Even at this sharp angle, the center of gravity regardless of the load, is well within the bounds of safety, assuring stability on track at all times.
MAGOR
AUTOMATIC AIR DUMP
CARS


Stability on track
Stability on track is an important Magor advantage because much of the dumping must be done from trestles or temporary structures.
When these big rugged cars loaded to capacity move smoothly to a 50 deg. angle in full dumped position, the center of gravity is well within the bounds of safety assuring stability on track at all times. There are no sudden or violent shocks and the car body is under control of the operator at all times.
MAGOR
AUTOMATIC AIR DUMP
CARS

BASE SUPPORTED R



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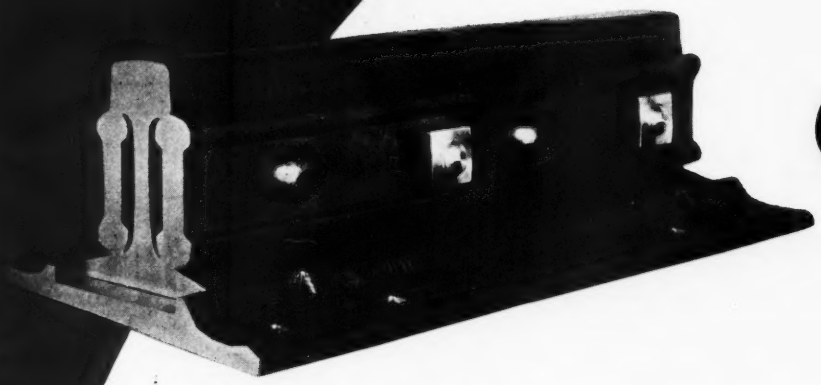
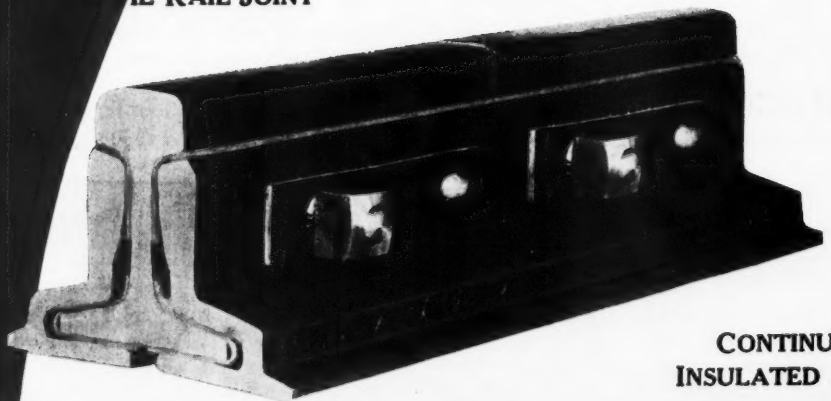


IE RAIL JOINT



CONTINUOUS
INSULATED JOINT

D RAIL JOINTS

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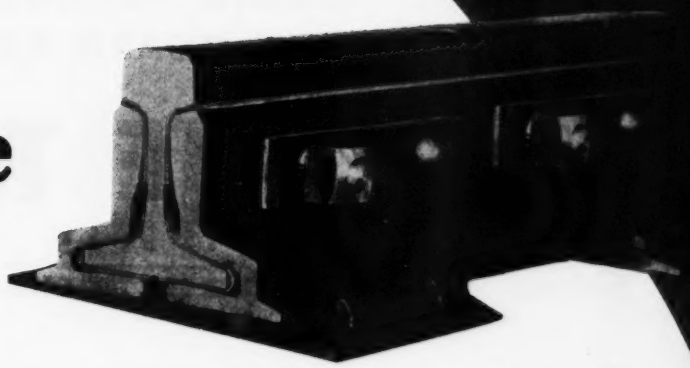
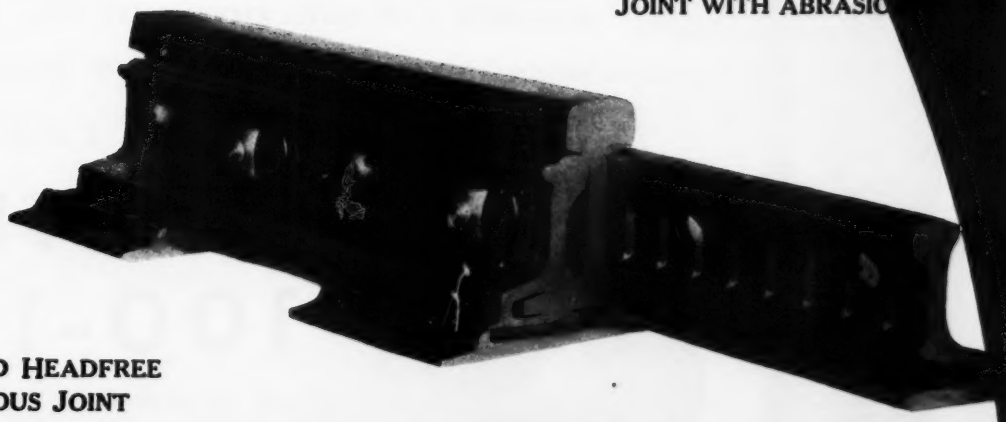


CONTINUOUS INS
JOINT WITH ABRASIO



REINFORCED HEADFREE
CONTINUOUS JOINT

DARDELET

THREADED

BOLTS AND NUTS

FOR

RAIL JOINTS
CROSSING FROGS
RIGID TURNOUT FROGS
SPRING TURNOUT FROGS
GUARD RAILS

HAVE THESE

AT THE TRACK SUPPLY ASSOCIATION EXHIBITION, SEPTEMBER 17-19, HOTEL STEVENS, CHICAGO, DARDELET THREADED BOLTS AND NUTS WILL BE DISPLAYED BY

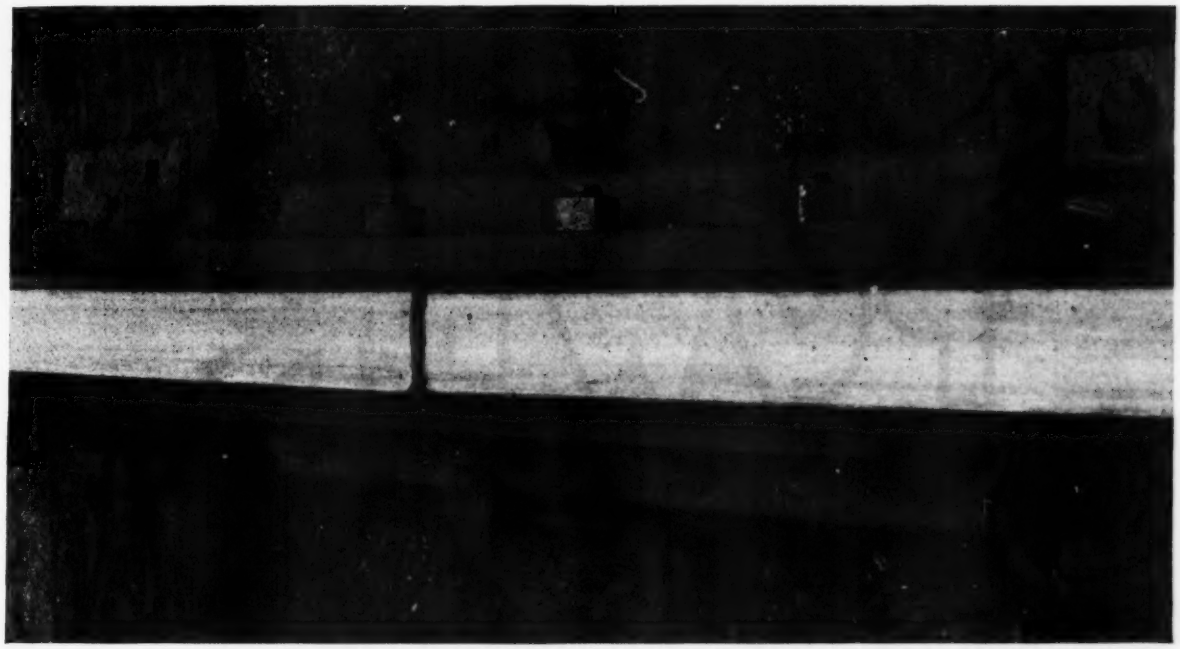
THE BETHLEHEM STEEL COMPANY

BOOTHS 100-101

AND BY THE

PETTIBONE MULLIKEN COMPANY

BOOTH 82



RAIL JOINT INSTALLATION WITH DARDELET HOT ROLLED TRACK BOLTS AND DARDELET HEAT-TREATED NUTS

ADVANTAGES

1. **The nut remains absolutely tight under all service conditions.**
2. **Assembly time is reduced, due to free running nut.**
3. **Auxiliary locking devices are unnecessary, therefore a shorter bolt may be specified.**
4. **Dardelet threaded bolts are stronger in tension and against shock than U. S. Standard threaded bolts because of greater root area and form of thread.**
5. **The Dardelet Thread is uninjured by the locking action, therefore both bolt and nut may be reclaimed for future use.**

The Dardelet Self Locking Screw Thread is protected by patents and is manufactured in the United States under license from the Dardelet Threadlock Corporation.

DARDELET THREADLOCK CORPORATION 120 BROADWAY, NEW YORK, N. Y.

NOTHING TAKES THE PLACE OF POWER

THAT'S ALWAYS AT YOUR SERVICE

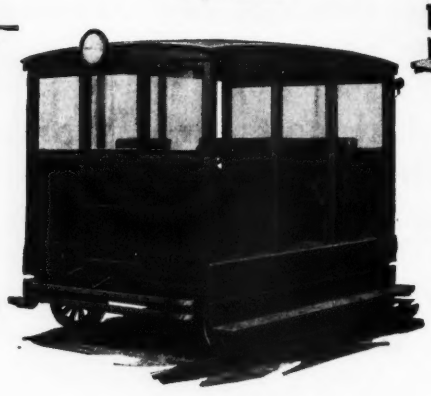
Kalamazoo 25A Motor Car has been especially designed to fill the need for a reliable, powerful car for extra gangs and hump yard service. It can be depended on for continuous operation in this heavy-duty service. Furnished with bodies adapted for every use of general construction gangs or inspection parties.

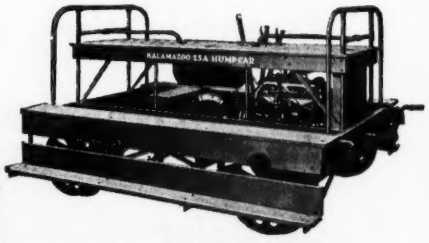
ESTABLISHED 1883

KALAMAZOO MEANS SERVICE TO YOU

Kalamazoo 25A Motor Car with Standard Body that Seats 12 Men.

Kalamazoo 25AC Motor Car with Inspection Body Seating 6 persons.



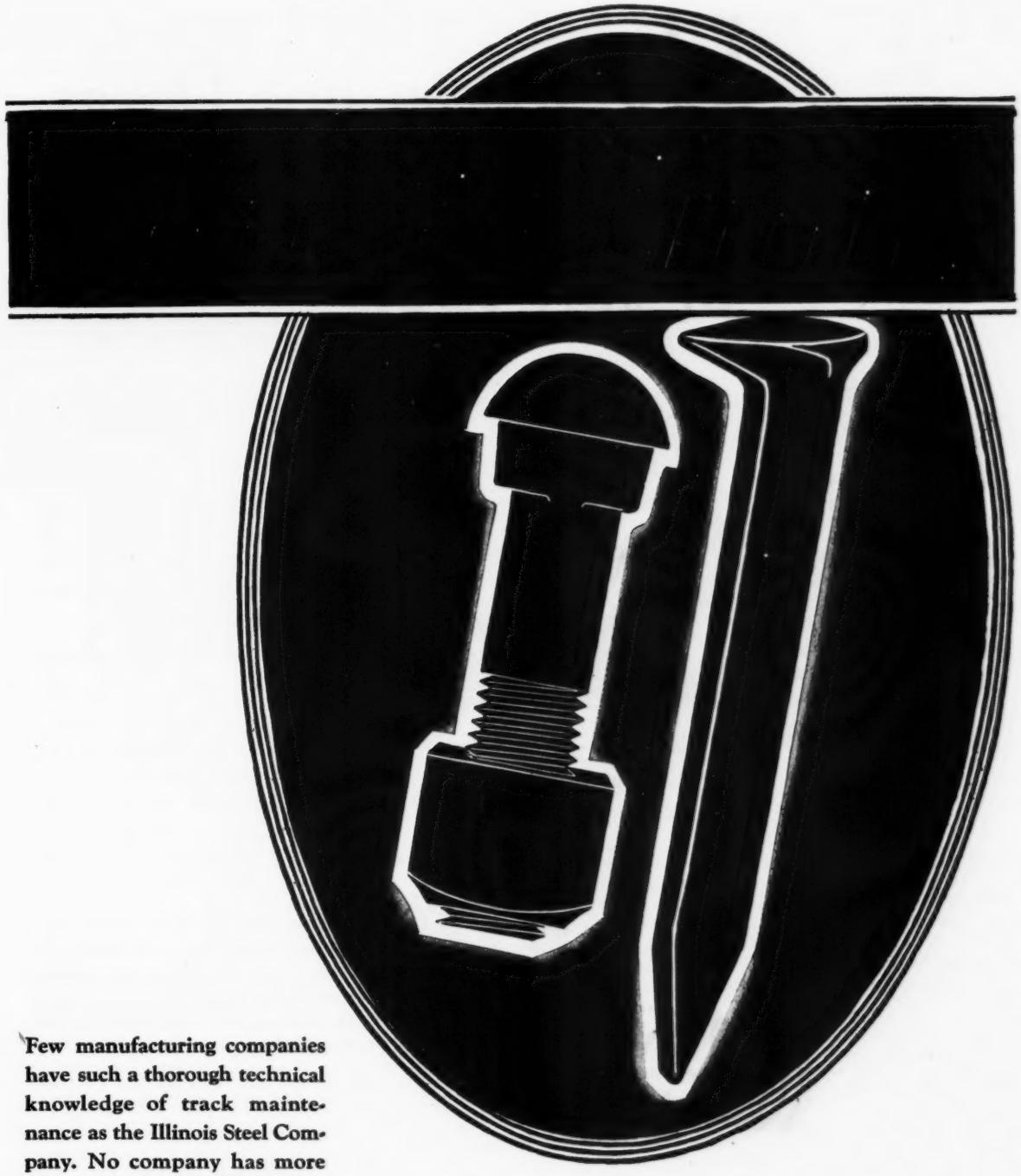


Kalamazoo 25A Hump Motor Car Equipped with Body Seating 24 Men.

KALAMAZOO RAILWAY SUPPLY CO.

MANUFACTURERS

Kalmazoo, Michigan, U. S. A.



Few manufacturing companies have such a thorough technical knowledge of track maintenance as the Illinois Steel Company. No company has more efficient facilities for the manufacture of Spikes and Bolts, or a more thorough system of inspection. Add to these advantages that of *central location* and you have the reasons for the wide use among railroads of Illinois Spikes and Bolts.

Illinois Steel Company
Subsidiary of United States Steel Corporation
General Offices: 208 South La Salle Street
Chicago, Illinois

Use Toncan Iron Drains to rid the road-bed of soft spots

CONSTANTLY increasing speeds and train loads are searching out the soft spots in the road-bed. Heavy loads form depressions under the track that tend to hold water.

To correct these conditions requires adequate sub-drainage facilities. Use drains of Toncan Iron to keep the road-bed firm and dry. Bury them deep if you will; secure in the assurance that Toncan Iron drains are strong and flexible to resist vibration and heavy loads.

When permanence is needed, as in corrugated culverts, Toncan Iron affords the greatest assurance of long life.

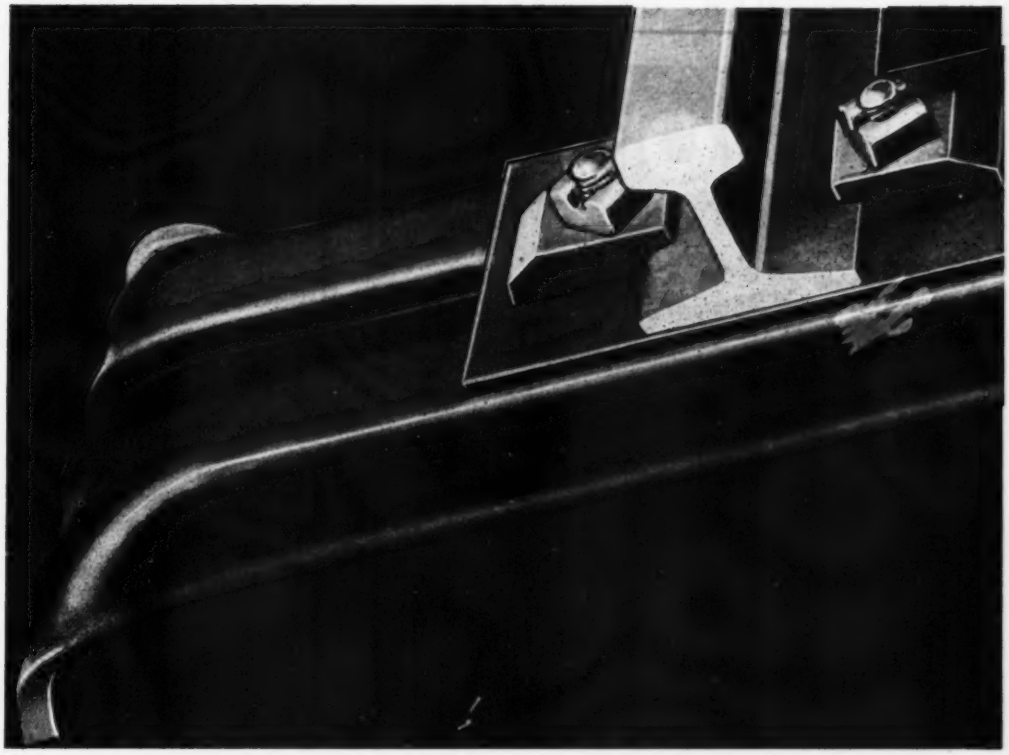
Toncan Iron builds up its well-known resistance to corrosion and erosion by the inclusion of copper and molybdenum. These elements give the naturally resistant iron still further protection against rusting and corrosion.

For permanence at reasonable cost, install Toncan Iron drains and culverts.

TONCAN CULVERT
MANUFACTURERS' ASSOCIATION
MASSILLON, OHIO

Plants located in all parts of the United States and Canada

TONCAN COPPER MO-LYB-DEN-UM IRON



A *steel tie* for use at water columns and in standing track

THE KEYSTONE Steel Tie No. 17 is a new heavy-duty tie for standard-gage track. At cinder dumps, water columns and standing track, where wood ties quickly burn out, the use of Keystone Steel Ties greatly reduces tie renewals. In such locations these ties last indefinitely.

The Keystone Steel Tie No. 17 may also be used to reinforce wood-tie track; one Keystone Tie to every two or three wood ties. With this type of construction the Keystone Ties carry the full strain of the rail fastenings, prevent spikes from shearing and the wood ties from becoming spike-killed, thus greatly prolonging the life of the wood ties. Further, Keystone Steel Ties hold the rails true to gage and in alignment. In sidings, yards, cinder dumps, round houses, and other locations where wood ties have comparatively short life, these steel ties will materially strengthen and prolong the life of the track structure.

The Keystone Steel Tie No. 17 is made of copper-bearing steel. The tie is channel-shaped and has a heavy, reinforcing bulb at the bottom of the sides. The ends are depressed and flared in the shape of a whale-tail, giving the tie a firm grip on the ballast. All rail fastenings are applied or removed from the top, without disturbing the tie or the ballast.

▼

This new steel tie as well as other important items of Bethlehem Track Equipment will be shown during the Road Masters and Maintenance of Way Convention at the Track Supply Association Exhibition, Stevens Hotel, Chicago, Ill., Booths 100-101.

BETHLEHEM STEEL COMPANY

General Offices: Bethlehem, Pa.

District Offices: New York, Boston, Philadelphia, Baltimore, Washington, Atlanta, Pittsburgh, Cleveland, Detroit, Cincinnati, Chicago, St. Louis.

Pacific Coast Distributor: Pacific Coast Steel Corporation, San Francisco, Los Angeles, Portland, Seattle, Honolulu.

Export Distributor: Bethlehem Steel Export Corporation, 25 Broadway, New York City.

BETHLEHEM

Keystone Steel Tie No. 17

ANOTHER TRIUMPH OF GENERAL ELECTRIC RESEARCH!

G-E-Glyptal Lacquer

REG. U.S. PAT. OFF.

INDUSTRY'S LIQUID ARMOR

They are *more than paint*—these new Glyptal Lacquers for every surface in the plant . . . metal, wood, plaster.

They *protect* with a film so tough it adds useful life. They *seal* pipes and tanks against leakage . . . bearings against oil loss and grit. They *insulate*.

G-E Glyptal Lacquers withstand high temperatures, weak acids, alkalies, and oil. They *adhere* firmly—even to galvanized iron. They're economical—sizing and priming materials are not needed when Glyptal Lacquers are used.

Send today for a sample color card to Section **M-8910**, Merchandise Department, General Electric Company, Bridgeport, Conn.

ALL SIZES
Half-pint cans to
52 gal. drums

COLORS

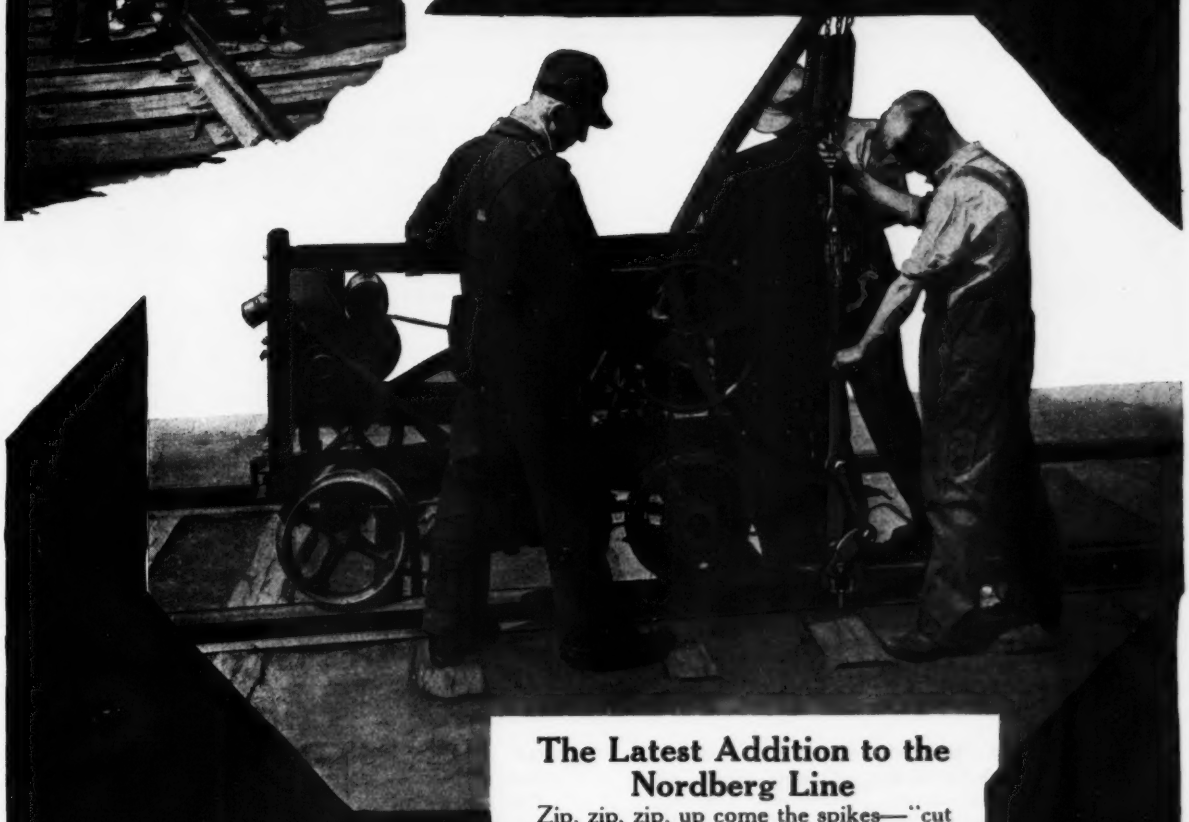
Red	No. 1201
Clear	" 1202
Blue	" 1206
Black	" 1209
Brown	" 1210
Green	" 1211
Aluminum	" 1212
Gray	" 1214
Gray	" 1217

GENERAL ELECTRIC

GLYPTAL LACQUER

MERCHANDISE DEPARTMENT • GENERAL ELECTRIC COMPANY • BRIDGEPORT, CONN.

--an
NO
POWER



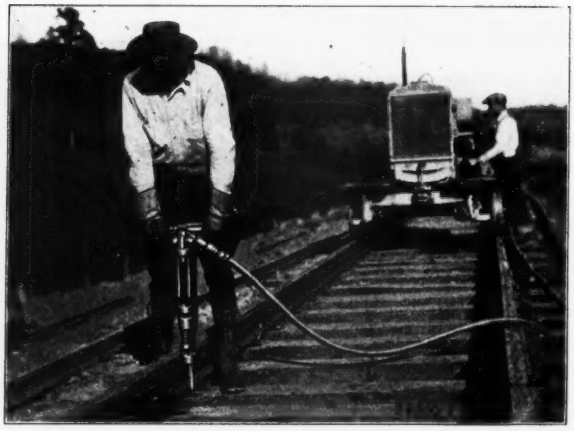
The Latest Addition to the Nordberg Line

Zip, zip, zip, up come the spikes—"cut throats" and "hump backs" regardless of how crookedly they were driven in or how solidly they have rusted in. With its straight up tug the Nordberg **Power** Spike Puller has pulled as many as 36 spikes a minute on bridges where the outer guard timber makes hand spike pulling exceedingly difficult slow and dangerous. And it never gets tired, but works just as fast at the end of the day as in the beginning.

These are reasons why the Nordberg **Power Spike Puller is being given an enthusiastic reception.**

Full catalog information on request

ORDBERG MFG. C
MILWAUKEE, WIS.



The CC-250 drives a spike in 5 seconds.

At left — The Size D Bonding Drill drills a ⅜" hole in 15 seconds.

At right — The 99C Wrench is ten times as fast as hand methods.

Labor-aiding tools on rail-laying work

Above are shown several tools from the Ingersoll-Rand line of labor-aiding machines for rail-laying operations. The complete line of air-operated tools includes; spike driving machines; spike pulling machines; machines for backing off and running on joint bolt nuts; machines for drilling rails, for drilling signal bond holes in rails, for running in and backing out screw spikes, for preboring ties for screw spikes, etc.

Many roads are making decided savings in their rail-laying by taking full advantage of the economies of these machines. They find they obtain greater production, a better quality of work, and decreased costs when these tools are adopted and gangs properly organized to work them.

INGERSOLL-RAND COMPANY - 11 Broadway - New York City

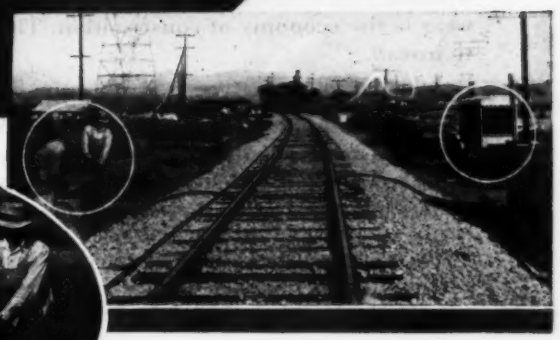
Branches or distributors in principal cities the world over

For Canada Refer—Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec

282-TT

Ingersoll-Rand

THE TIME AND MONEY SAVER



The "WOLF"

Portable Timber Sawing Machine

Available in:

A.C. 110 or 220 Volts, 60 Cycle, 3 Phase.

D.C. 115 or 230 Volts.

Air Driven Ingersoll-Rand or Chicago Pneumatic Motor.

Gasoline Engine Driven.

Standard machine has capacity of 24". However, special capacities as 16", 36", 42" and 48" can be supplied.

Of the 450 "WOLF" Saws now in use nearly 100 are serving the railroad field.

The "Wolf" will help reduce your cost of cutting heavy timber. Let us show you results secured by other roads.

Send for new 16 page bulletin showing all types of saws and representative installations in many fields of endeavor

REED-PRENTICE CORPORATION

Worcester, Mass., U.S.A.

Now.. Better Right-of-Way Protection

with

NATIONAL

DIRT SET ANCHOR

END and CORNER POSTS

Here is one of the most important improvements ever offered in the science of fence construction for right-of-way protection. Fence posts which combine, in the highest degree, these three vital points of excellence—

STRONGER... *Save Time and work*

They afford the maximum rigidity and resistance against time, weather and every kind of strain. Added to their efficiency in wear is the economy of construction. They are simple and easy to install.

Here is method of setting. Bore a 9-inch hole—drop in post—turn post around using brace as a lever. Anchor plates are thus anchored in solid ground at bottom of post hole. You are now ready to stretch your fence. No delay; just a quick, easy and satisfactory job. And when done it is done "for keeps."

From every point of view of long-time protection and economy, first and last, your maintenance department will find it best to specify the Fencing that is internationally known and used.

AMERICAN FENCE

For there is no question of the need for protection of the life and property bordering the right-of-way. To neglect it is to take dangerous chances. Don't wait for a heavy damage suit which would cost more than the efficient safeguard of a good fence.

American Railroad Fence, National End and Corner Posts and Banner Steel Line Posts meet every specification recommended by the American Railway Engineering Association.

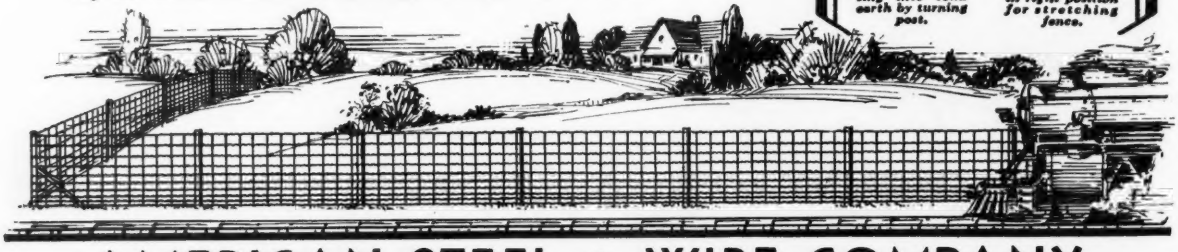
EXPANDING ANCHOR

Size when folded 5" by 7⅝"— diagonally 9½".

Figure 1 Showing folded anchor in bottom of hole, hole 37" deep, 9" wide.

Figure 2 Expanding anchor partly opened and cutting into solid earth by turning post.

Figure 3 Anchor expanded. Post can be turned around as many times as necessary clockwise to bring post in right position for stretching fence.



AMERICAN STEEL & WIRE COMPANY

SUBSIDIARY UNITED STATES STEEL CORPORATION

208 S. La Salle Street, Chicago

Other Sales Offices: Atlanta Baltimore Birmingham Denver Detroit Kansas City Memphis Milwaukee Pittsburgh Salt Lake City St. Louis

Pacific Coast Distributors; Columbia Steel Company, San Francisco Los Angeles Portland Seattle Honolulu

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Boston Buffalo Cincinnati Cleveland Dallas Minneapolis-St. Paul Oklahoma City Philadelphia Wilkes-Barre Worcester

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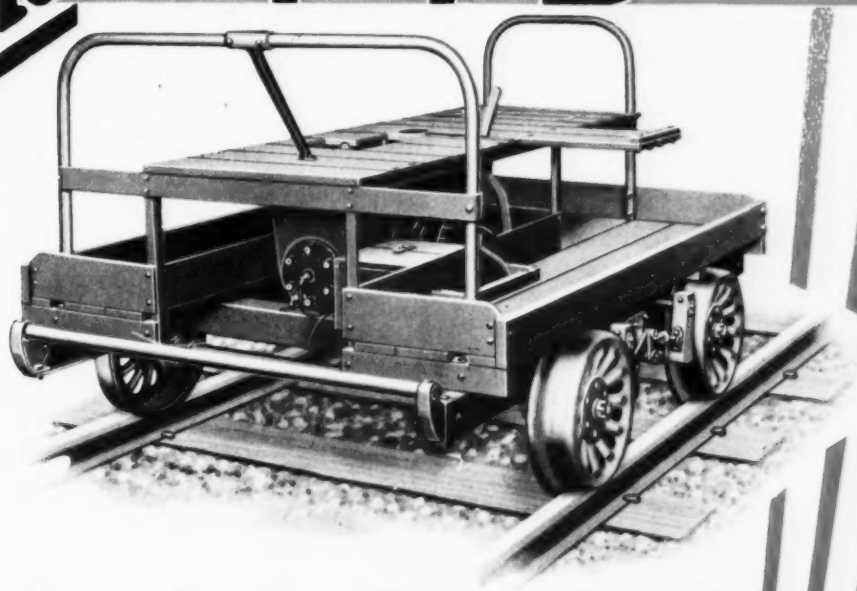
"Sheffield 44-B"



What is back of the "Sheffield" record of performance?

"No railway motor car can give more service than is built into it!" This axiom is the ruling thought behind the design and manufacture of Sheffield Cars.

Every part of the Sheffield Motor Car is built to give maximum service. In not a single instance has quality been sacrificed to price. There are no weak links in the "Sheffield"—no cheapened construction that needs to be covered up by drawing attention to minor refinements. *Every* part of the car will stand the closest inspection.

(Continued on next page)

Timken Tapered-Roller Double Bearing Assembly and section of Sheffield Pressed Steel Wheel. Although the capacity of one bearing is far above actual requirements —two bearings are used in each axle box.

TIMKEN BEARING EQUIPPED

FAIRBANKS-MORSE

MOTOR CARS

TOWER, HOISTING AND WEIGHING EQUIPMENT

{Continued from preceding page}

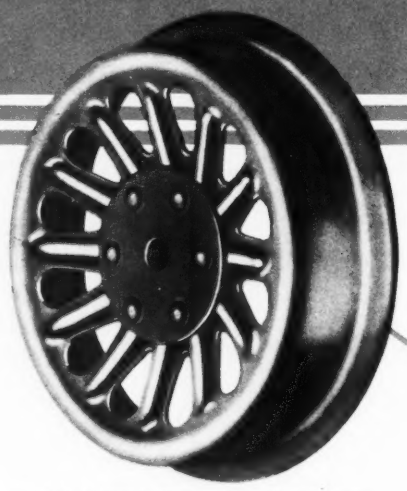
Second, "Sheffield" design is far in advance of the field. Improved construction characteristics and refinements are natural results of more than 34 years of motor car building experience. Unequaled research and manufacturing facilities have assisted F-M engineers in producing the finest car that can be built. "Sheffield" was first on the rails. It is still first.

Before you buy a railway motor car, get the facts about "Sheffield." See for yourself how sound design and quality construction of *every* part make a motor car that is conspicuous for dependability, low maintenance and long life. "Sheffield" is the *lowest over-all cost* car on the market—the greatest dollar-for-dollar value in railway motor cars.

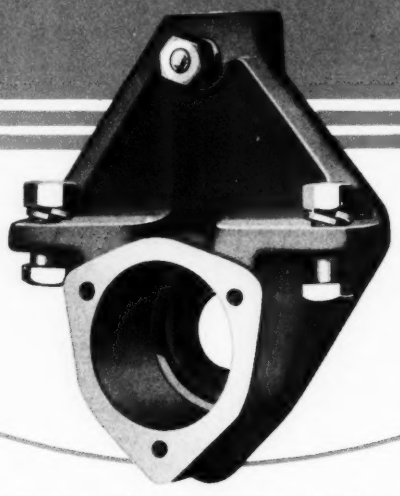
FAIRBANKS, MORSE & CO., *Chicago*

Manufacturers of railway motor cars; hand cars; push cars; velocipedes; standpipes for water and oil; tank fixtures; stationary and marine oil engines; steam, power and centrifugal pumps; scales; motors and generators; complete coaling stations.

TIMKEN BEARING EQUIPPED



Well balanced design and sturdy construction contribute to the value of Sheffield Pressed Steel Wheels. Ground treads insure perfect roundness.



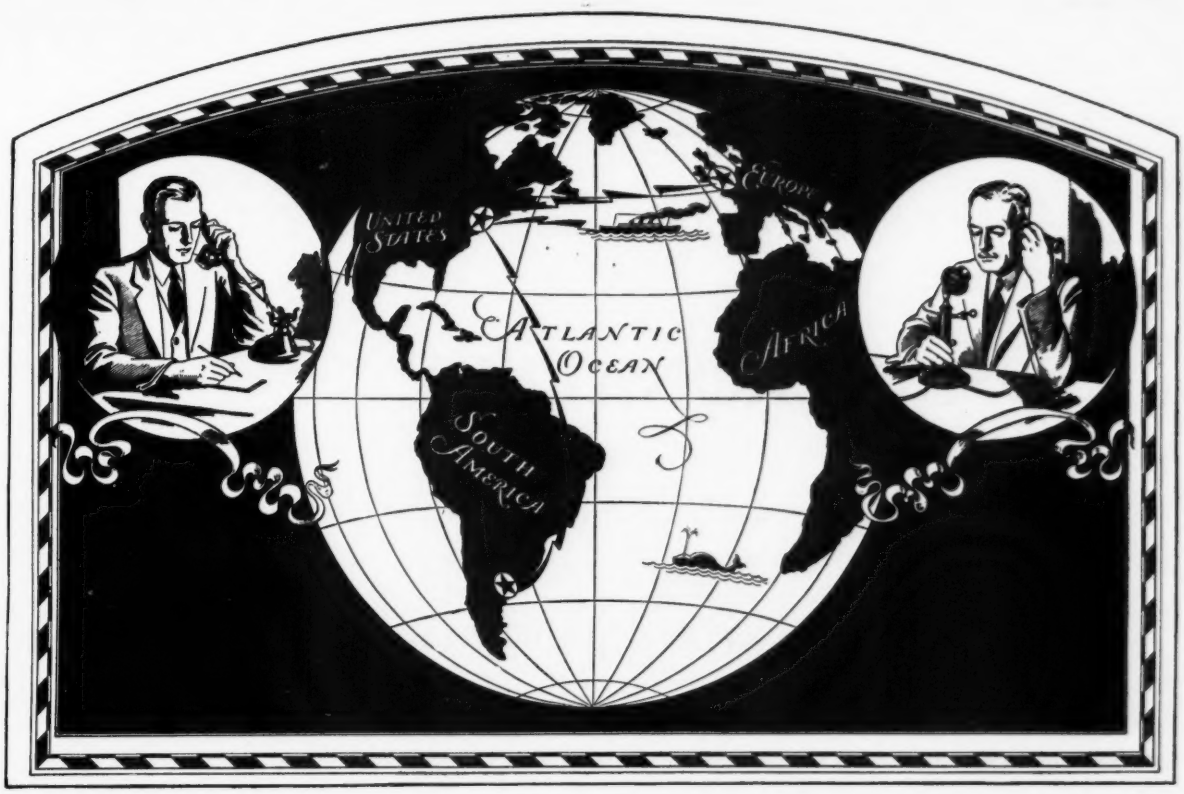
Axle Bearing Box with the cover removed to show the secure mounting afforded by Sheffield construction. As oil is used for bearing lubrication, oil cups are located at opening through the deck. Oil tubes run to the bearings.

RA21.75

FAIRBANKS-MORSE

MOTOR CARS

POWER PUMPING AND WEIGHING EQUIPMENT



Linking the continents with speech

TODAY, through the Bell System's radio-telephone service, you can talk directly from your home or office telephone to most of the countries of Europe, to Argentina, Chile and the city of Montevideo, Uruguay, or to several great transatlantic liners while at sea.

Before long, your telephone horizon will be extended to Hawaii and other islands in the Pacific, to the mainland of Asia and to additional countries in Europe and South America. Bell System engineers are steadily enlarging the scope of voice-to-voice contact, bringing new continents, new nations, new cities and hamlets within reach of your telephone.

Talking to Europe, to South America, to ships at sea, is almost as satisfactory as an across-the-desk conference. You can transact business and exchange personal messages with the ease and clearness of an ordinary long distance call. Questions can be settled as they arise.

Recent reductions in charges have lowered the cost of a three-minute conversation between New York and London, and New York and Buenos Aires, to $30. A slight additional charge is made for calls between more distant points.

Transatlantic telephone service has won an important place in international communication. It has brought the factor of *personality* to the daily contacts between the Old World and the New. It is a furtherance of the Bell System's aim: *that you may be able to talk with any one, anywhere, at any time.*

Do You Want Tool Service with Safety?

USE VERONALLOY TOOLS

CHISELS—ADZES—SLEDGES—MAULS

WILL NOT SHATTER OR FLY

ALL REPAIRS AND
REWORKING CAN BE
DONE ON SECTION
HOUSE GRINDER

A test lot will convince you

VERONA TOOL WORKS

Pittsburgh, Pa.

Est. 1873

ELECTRICITY IS THE MODERN POWER

GOOD TRACK

SYNTRON ELECTRIC TAMPERS with their Constant Hammer Blow put up well surfaced track that will stand up under the heaviest traffic.

They will do it economically because of the small gangs necessary to handle the light, flexible equipment and the low operating expense of gasoline and oil.

The tamping tool is extremely simple, consisting of two magnets reciprocating a piston that strikes directly on the tamping bar.

The design of the tamper maintains a constant blow against the ballast regardless of the skill of the operator or the effort applied.

The small, portable power plants in addition to tie tampers will operate screw spike drivers, nut tighteners, rail drills, rail saws, rail millers, portable electric drills, hammers and saws, rail grinders and flood lights providing twelve month use of the equipment.

Built in 4-, 6-, 8-, 12-tool outfits.

SYNTRON CO., PITTSBURGH, PA.
15 Factory Service Branches

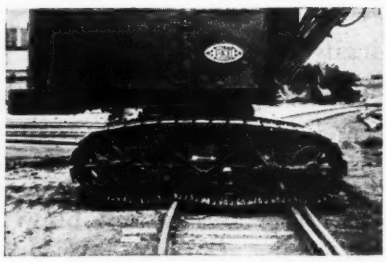
CRANE SERVICE THAT IS INDEPENDENT OF TRACKS

YOUR P & H Crawler Crane goes wherever materials are to be handled. It multiplies the size of storage area because it is independent of tracks—goes anywhere, over any kind of ground, on its Corduroy (crawler) traction.

Switching and spotting of cars are minimized because of the P & H Crane's wide radius of operation and its ability to work at either side or end of a car.

There is no standby expense. Operating cost stops when the engine stops.

All sizes (from 8 to 50 tons capacity) have fast line and swing speeds. This assures big production with hook, magnet, sling or bucket.



P & H Tractions can cross railroad tracks without injury to the tracks or tractions.

Ratings are based on but 75 per cent of tipping load, insuring stability and ample margin of safety.

If you have a handling or storage problem, you will want the special P & H Crane Bulletins describing all models.

HARNISCHFEGER CORPORATION

Established 1884

4420 W. National Avenue, Milwaukee, Wisconsin

Offices and Agents in All Principal Cities

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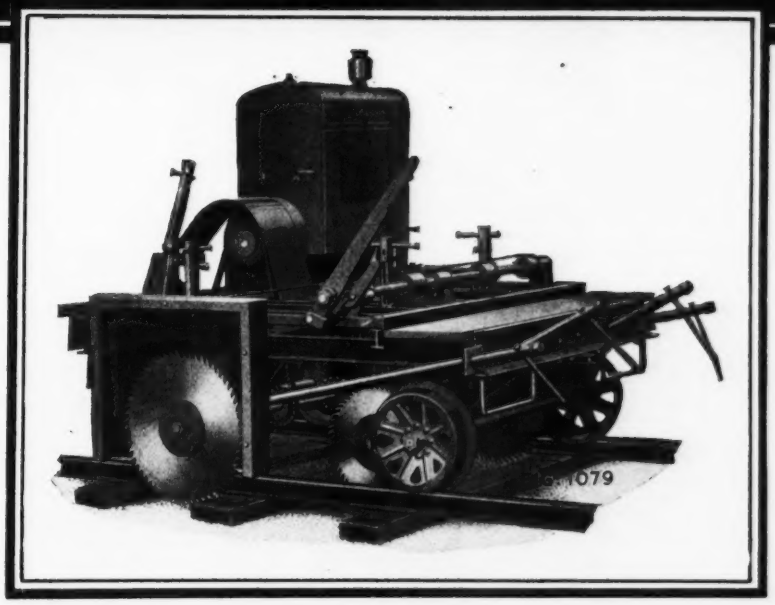
P&H CORDUROY [CRAWLER] CRANES



NEAFIE TIE SCORING MACHINE

THE Neafie Tie Scoring Machine has proved by performance its ability to reduce the cost of rail laying and prolong the life of ties in track by assuring a uniform bearing for the new rail.

Normally when ties are adzed by guess, the surface upon which the tie plate rests may cant either inward or outward. Usually the greatest depth of the cut is immediately under the rail, thereby throwing most of the tie bearing at the ends of the tie plate so that the plate cuts into the wood fibre and shortens the life of the tie.

The Neafie Tie Scoring Machine eliminates this tie destroying condition. It scores all ties to proper depth in four places furnishing an accurate guide for adzing and assuring a full even bearing for the tie plates in a horizontal plane or at any desired inclination.

In service, the machine is easily handled and operated. It is self-contained and built to be moved along the existing rails making a cut at right angles to the plane of the rail heads, 9 3/16" outside of each gauge line and 6 13/16" inside of each gauge line. These dimensions will be increased by the kerf of the saw in both cases. The maximum saw, 26" diameter, is used to make the outside cuts and 19½" in diameter for inside cuts. Each saw is adjustable for depth of cut by sixteenths of an inch and is locked at each setting. All saws are raised to traveling position by one hand wheel, a ratchet and wheel holding them in place.

When the car is traveling along the right of way both saws will clear the top of the rail by 2 inches. The saws are guarded to protect workmen against injury.

The FAIR RAIL ANTI CREEPER

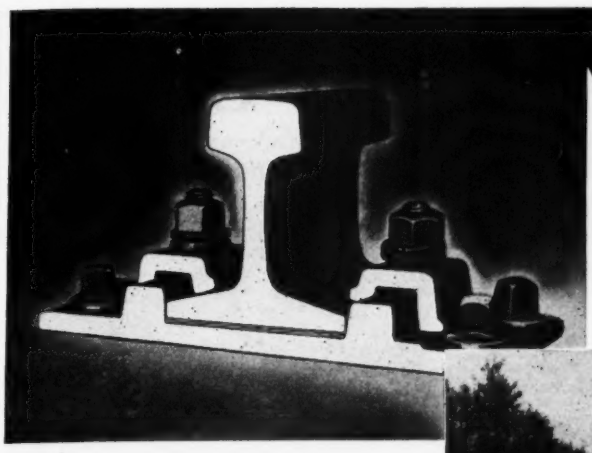
You See It Everywhere

Its wide-spread use is due to its merit which has been recognized by the railroads not only in this country but in such far off lands as China and Japan.

THE P. & M. CO.

Railway Exchange, Chicago

New York Montreal London Paris Sydney Calcutta



NEW

Introducing a modern type of track construction

GEO

To meet the exacting demands of heavy duty, high speed transportation, Carnegie Steel Company is now prepared to furnish G. E. O.—a new type of track construction marking a distinct advance from present day methods. G. E. O. has met with sensational success abroad. Five years ago it was adopted as standard in Germany and more than 6000 miles of G. E. O. track have since been laid. Its use has spread rapidly to other countries, and here in America extensive tests are already proving its superiority.

G. E. O. track construction practically eliminates mechanical wear between tie and plate. Joints can be laid close and longer rails may be utilized, making quieter and smoother riding track. The life of both rail and tie is increased, and rails can be renewed without disturbing tie plates or ties on well compressed ballast.

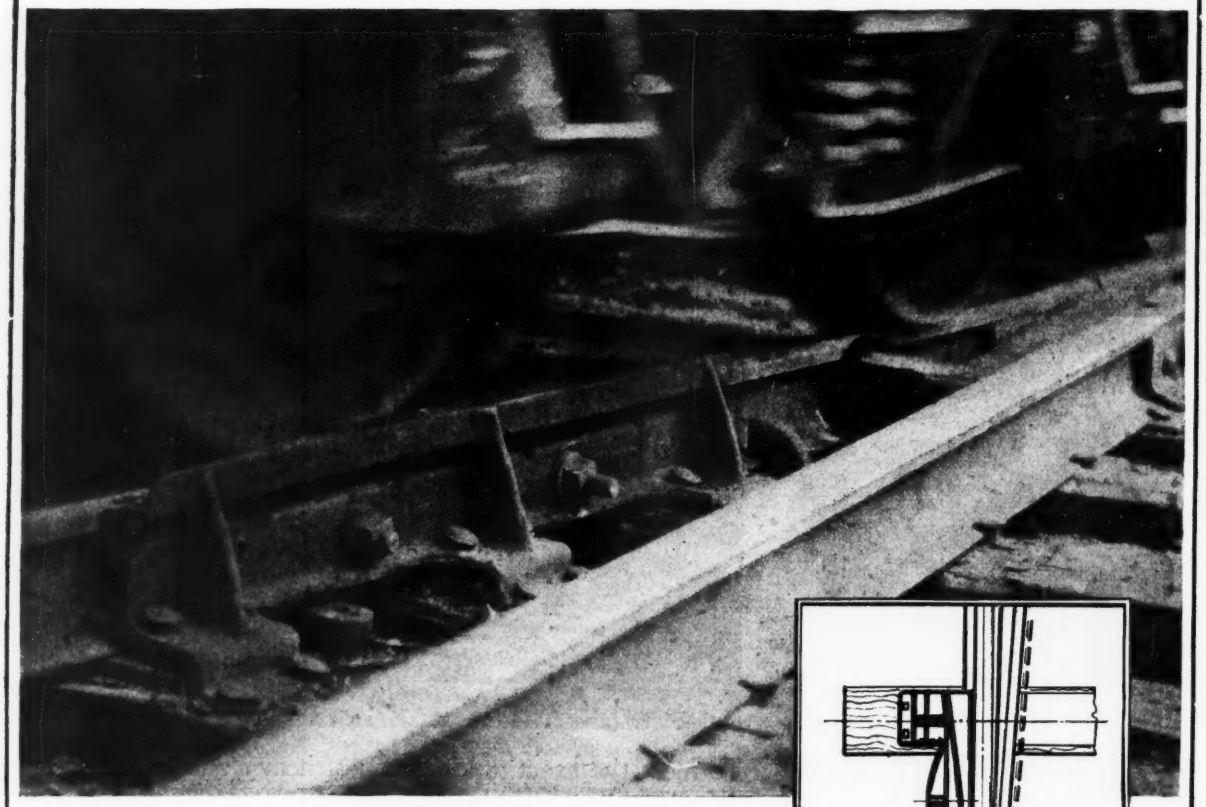
Carnegie Steel Company is the sole manufacturer and distributor of G. E. O. track materials in America. Descriptive literature will be sent at your request, and Carnegie engineers are at your service at all times.

CARNEGIE STEEL COMPANY - PITTSBURGH, PA.

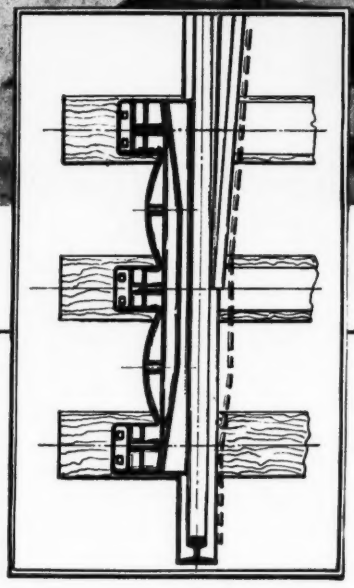
Subsidiary of United States Steel Corporation 93

GEO TRACK CONSTRUCTION

The Q & C Switch Point Guard



Untouched photograph showing a typical installation of a Q & C Switch Point Guard engaging the wheels ahead of the switch point



Line drawing of a three-tie installation showing the course taken by the wheels (dotted line) engaging the guard. The long angle of deflection reduces the shock between the track and rolling stock to a minimun.

Reducing Switch Point Renewals to a Minimum

The excessive wear on switch points from "crowding wheels" can be reduced to a minimum by using the Q & C Switch Point Guard. Made of full manganese steel and properly reinforced, this guard will prolong the life of the point many times.

The double angle of deflection (see diagram) gives protection to the switch point in either a facing point or trailing movement. They are designed to fit special switch plate conditions.

We will be glad to furnish full information and blue prints to engineers interested.

Tne Q & C Company, 90 West Street, New York

CHICAGO SAN FRANCISCO ST. LOUIS

Q AND C

Roa[illegible]sters

You A[illegible]ordially
Invite[illegible]o Visit
Boo[illegible]n 67

WOODINGS FORGE & TOOL CO.

WORKS AND GENERAL OFFICES

VERONA, PENNA.

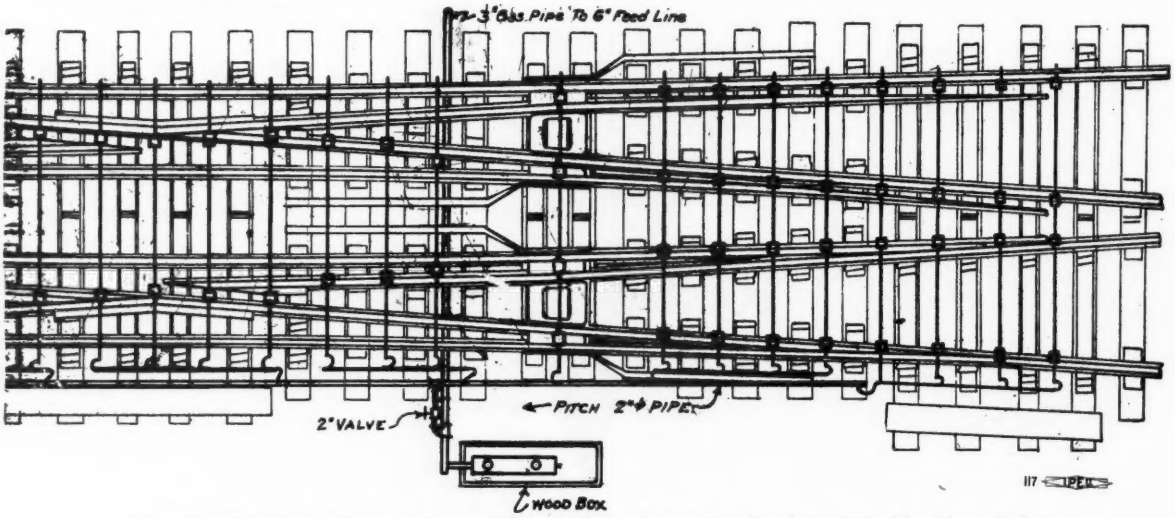
VAUGHAN GAS SWITCH HEATERS

On Guard, Every Hour, Day and Night, in Any Emergency

Chicago Union Station—General View of South Approach. The four double slips in background equipped with 376 Vaughan Gas Burners. A 50 mile wind prevailed during this 15" snow storm, Dec. 18-19, 1929. No delay or outside help required at these slips during this 40 hour blizzard

From a sleet storm to a blizzard, in high winds and heavy drifts, in any temperatures, in storms of any duration, the Vaughan Gas Switch Heater is the silent sentinel, day and night to keep switches and slips open and operative, permitting trains to pass through junctions and into terminals without delay.

More than 30,000 Vaughan Gas Switch Heaters bear out the above claims through years of service in many important yards and terminals.



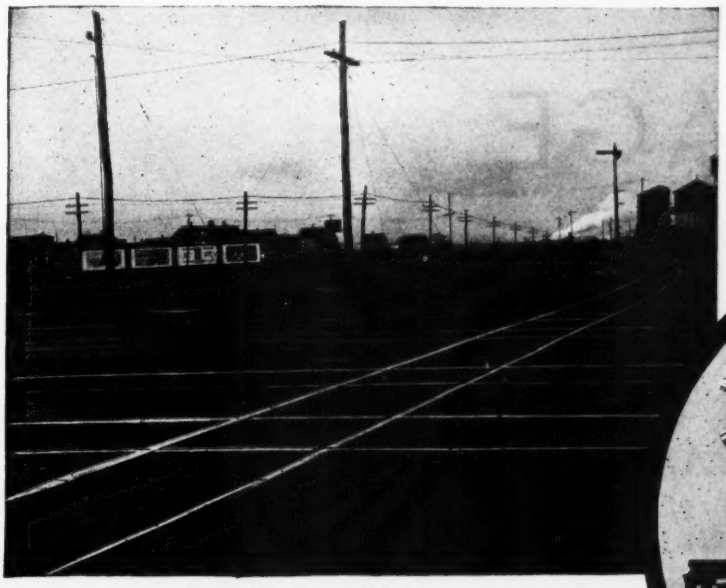
Vaughan Gas Burner lay-out for movable center points and end points of double slip switch

RUBY RAILWAY EQUIPMENT COMPANY

Real Estate Trust Bldg. **Philadelphia, Penna.**

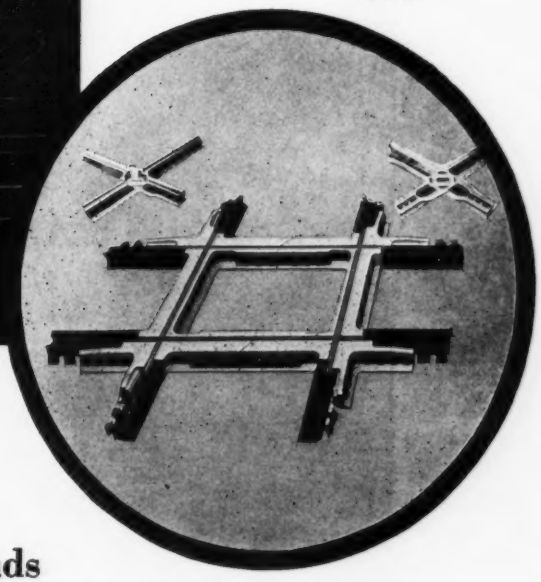
Manufacturers and Distributors of

Vaughan Gas Switch Heaters—G. & R. Radiation Electric Switch Heaters—Improved Keim Contact Electric Switch Heaters



The New WHARTON crossing at Elizabethport, New Jersey

Patent No. 1591706



Now cutting maintenance costs on over fifty leading railroads

The New Scientifically Designed WHARTON Crossing

CROSSING maintenance is no longer an indeterminable item with the many leading railroads that have adopted the NEW scientifically designed Wharton crossing.

For these roads no longer depend on crossings whose designs are not based on an accurate knowledge of their reaction to the severe stresses imposed in service.

The New WHARTON Crossing is the first scientifically designed crossing—the result of a long engineering study which has at last determined the proper design and distribution of metal to withstand the stresses encountered under severest operating conditions. In addition, it is made of dependable TISCO Manganese Steel.

You will want to learn more about the design of this proven crossing—and the service it is giving on the tracks of over fifty of the leading Steam and Electric Railway Companies. Write for bulletin 1 C.

Guard Rail Clamps

—

Insulated and Non-Insulated Gauge Rods

—

Wharton-O'Brien Insulated and Adjustable Pull and Lock Rods

William Wharton Jr. & Co., Inc.

EASTON, PENNSYLVANIA

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Not Only YARDAGE

But MILEAGE Too

It's this combination that keeps the 2030's work reports so FULL

Bigger yardage of output at a dozen different hard digging and lifting tasks. That is expected of the Bucyrus-Erie 2030 gas convertible. Compact, perfectly balanced, ruggedly built, with great power in reserve—of course it comes through.

But output alone isn't a measure of this excavator's usefulness. There's its *mileage!*

Mile post 27 today, widening right of way—M. P. 341 tomorrow, cleaning out a ditch—back in the terminal the day after, loading ballast. That's just an ordinary schedule for the 2030. It gets each job done ahead of time, climbs aboard a drop-end gondola without dismantling, and reports to duty anywhere else on the division on overnight notice.

Easily converted on the job from shovel to dragline, clamshell, crane, magnet crane or pile driver—the 2030 does many different tasks well and with a minimum of lost time. Let us send you a complete description.

A-166—10-30—REM

BUCYRUS ERIE

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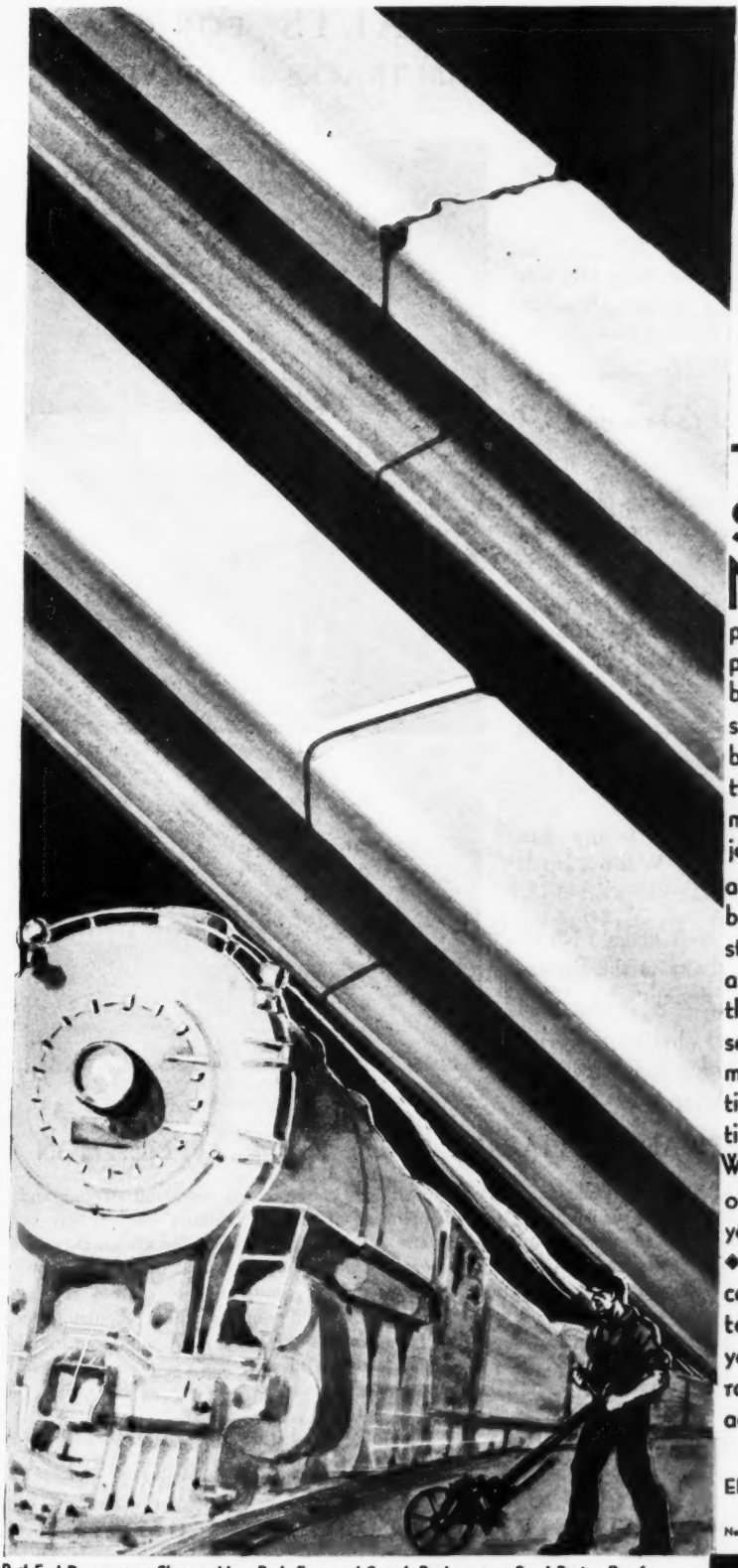
Representatives throughout the U. S. A. Offices or distributors in all principal countries. *Branch Offices:* Boston, New York, Philadelphia, Atlanta, Birmingham, Pittsburgh, Buffalo, Detroit, Chicago, St. Louis, Dallas, San Francisco.

BUCYRUS-ERIE COMPANY, manufacturers of the only complete line—all sizes, types and powers. *Plants:* S. Milwaukee, Wis.; Erie, Pa.; Evansville, Ind. *General Offices:* S. Milwaukee, Wis.



Rail End Restoration..Slotting New Rail..Frog and Switch Reclamation..Steel Bridge Reinforcement

PREVENT CHIPPED RAIL ENDS

Lease

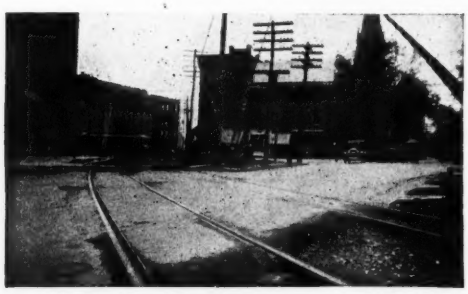
THIS TELEWELD SLOTTING TOOL

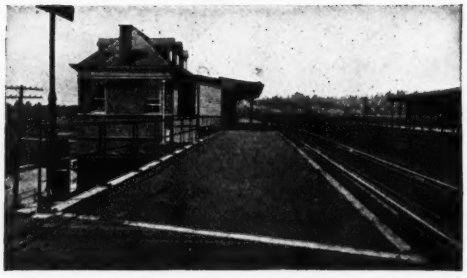
NOW TELEWELD engineers offer you the tool you have always needed to prevent chipped rail ends—a new foolproof unit for beveling and slotting rail before it has a chance to chip. ◆ This simple TELEWELD tool can be operated by unskilled labor. It is easy to handle and transport. One man covers one-half to one mile of track a day rolling the unit from joint to joint between each beveling operation. The unit clamps rigidly to the track by depressing the foot lever . . . a few strokes of the cutting lever and you have a perfectly beveled and slotted joint, one that will not chip. ◆ You owe it to yourself and your road to investigate this new method of treating rail ends. It is a positive, proven operation that will save you time, money and later grief. The TELEWELD Slotting Tool is leased on the basis of actual track miles treated. Keep it the year 'round . . . pay for it only when in use. ◆ TELEWELD will be glad to send you complete information on request. Arrange to secure this Slotting Tool now, before your new steel has a chance to deteriorate. It simplifies track maintenance and adds to the life of your rail. ❖ ❖

ELECTRIC RAILWELD SALES CORPORATION
RAILWAY EXCHANGE BUILDING · CHICAGO
New York • Cleveland • Montreal • Salt Lake City • Boise • Spokane • San Francisco

HEADLEY EMULSIFIED ASPHALTS FOR GRADE CROSSINGS, STATION PLATFORMS, WALKS, TEAM TRACKS *and* DRIVEWAYS

HEADLEY No. 1 for Summer Use Only
HEADLEY No. 2 (Viafalt)
for Summer and Winter Use





SAFETY, simplicity of application, low first cost, long life, less expensive maintenance, smooth waterproof surface, freedom from damage to dragging train equipment—all demand that you try Headley Emulsified Asphalts at the first opportunity.

Only HEADLEY EMULSIFIED ASPHALTS have these advantages

Equally desirable for new construction, for resurfacing old brick, wood block, concrete or macadam, for binder course, wearing surface, seal coat, etc.

Come in liquid form, pour freely, and are applied cold. No chopping of material or container, no waste, no heating kettle, no tedious labor and no skill required for application. Any section gang can get perfect results.

Mixed by hand or machine at point of application, placed as mixed and finished surface is ready for service with practically no delay for curing and drying.

Bond any clean aggregate perfectly and adhere firmly to any clean solid foundation, wet or dry. Remain tough. Will not ripple in Summer or crack in Winter.

No adulterant mineral suspending agents and inert fillers. No ingredient impairs bonding, density or durability of the finished surface. Not "reversible" after thorough drying.

Useful properties fully retained. No beneficial physical properties of the asphalt are impaired or permanently lost as when asphalt is dissolved by a "cut-back" process, or mixed with fillers that have no protective qualities.

No dangerous solvents to evaporate and create fire hazard. No flammable or toxic fumes.

Very stable in the container. Long storage produces no appreciable sedimentation or separation.

HEADLEY VIAFALT FOR WINTER APPLICATION

SAME as Headley Emulsified Asphalt No. 1, but able to withstand freezing and thawing with absolutely no impairment of utility for future use. . . May be stored in the open in any weather, and after freezing, is ready for use on thawing. This achievement, without the use of anti-freeze compounds that impair the life of the finished pavement, permits the finest type of construction to proceed progressively, rapidly and almost without hindrance in cold winter weather. Applying the binder course to a frozen surface does not affect the bond. If binder course and wearing surface freeze, they set up perfectly on thawing and are none the worse.

Literature and Specifications covering standard applications will be mailed on request, and our Research and Development Department will co-operate in connection with new or exceptional uses.

Shipped in tank car lots, and 50-gal. steel drums

HEADLEY EMULSIFIED PRODUCTS COMPANY

Emulsified Asphalts for Industrial Uses. Largest Exclusive Manufacturers since 1908

Franklin Trust Building, Philadelphia

Chicago Office: One La Salle Street Building

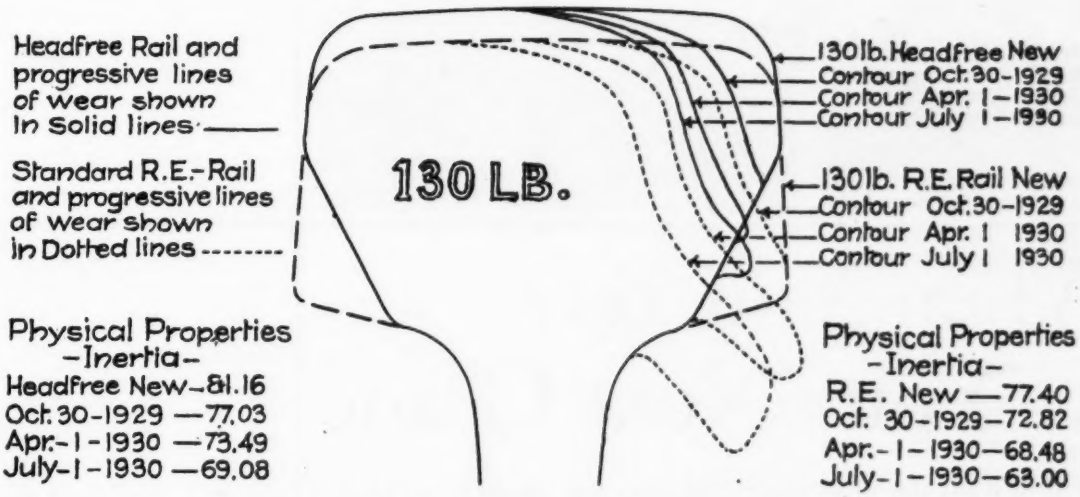
Works: Marcus Hook, Pa.

HEADLEY Emulsified ASPHALTS
REG. U.S. PAT. OFF

Headfree Rail

THE LATEST STUDY OF TEST-NO-1-7°38′ CURVE

LAID MARCH 15-1929.



Headfree When new-a-5.4% Stiffer Rail
Headfree after 15 Months-a-9.2% Stiffer Rail

After having a Tonnage life of 32,600,000 Tons or 372 Days service on the high side of a 7°38′ Curve, on a 2.2% mountain grade Headfree Rail had 0.71 square inches of metal abraded while the 130 R.E. Rail had 1.16 Square inches of metal abraded.—

Assuming that the 130 lb. R.E. Rail has now reached the Limit of Wear the average square inches of metal abraded per One Million Tons of Traffic would be equivalent to approximately .036 of a square inch.—

As the Headfree Rail still has .45 square inch of metal to abrade before reaching the Same Limit of Wear as the 130 Lb. R.E. Rail, the Headfree Rail will carry 13,000,000 additional tons of traffic before reaching the same Limit of Wear.—

Putting these facts on percentage basis and comparing the life of the two rail sections we will have the following.

Assume the life of 130 R.E. Rail to be 100% with 32,600,000 Tons of traffic to its credit, the Headfree Rail will carry 13,000,000 additional tons or a total of 45,600,000 which means a 40% greater tonnage life.—

The Economy in dollars that can be had by the use of Headfree Rail under like conditions is very apparent.

Information on other test curves-both high and low rails and on Tangent will be given at a later date.

Patented in the United States & Canada.

License to roll Headfree Rail may be had by Railroads from

THE THOMSON RAIL CORPORATION
OF NEW YORK
Pennsylvania Building — Philadelphia

Fifteen-ton, gasoline operated crane equipped with Industrial Brownhoist Clamshell. Industrial Brownhoist Gas Cranes range in capacity from 6 to 40 tons; those up to 15 tons capacity may be furnished with railroad or crawler trucks.

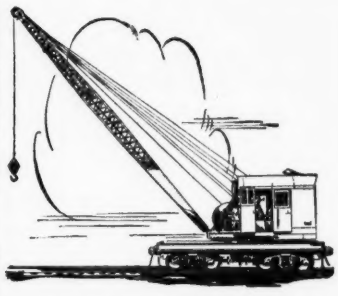
When You Buy Your Next Crane

You'll want the most up-to-date machine on the market, one which will be adaptable to all of your handling needs and one which will show a maximum saving. These are some of the advantages you get in buying an Industrial Brownhoist crane.

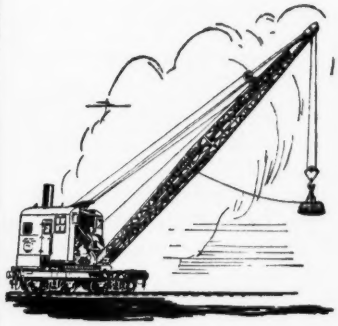
Industrial Brownhoist, the country's pioneer locomotive crane builder, has specialized for over fifty years in the design and manufacture of these machines. Capacities range from 6 to 200 tons, by far the most complete line ever built, and cranes are furnished with steam, gas, electric or Diesel engine power.

Tried and proved worthy through the years, on all kinds of handling work, these cranes have justified the confidence that the country's leading companies have placed in them. As a result, far more Industrial Brownhoist cranes are in service than any other make.

If you are undecided as to the correct type of handling equipment for your work, our nearby factory trained representative can give you a lot of helpful facts on the subject.



Diesel powered 25-ton capacity Industrial Brownhoist crane on hook work.



Eight-wheel steam crane equipped with electric generator set and lifting magnet.

Industrial Brownhoist Corporation, General Offices, Cleveland, Ohio

District Offices: New York, Philadelphia, Pittsburgh, Detroit, Chicago, New Orleans, San Francisco, Cleveland.

Plants: Brownhoist Division, Cleveland; Industrial Division, Bay City, Michigan; Elyria Foundry Division, Elyria, Ohio.

INDUSTRIAL BROWNHOIST

PAGE FENCE

AMERICA'S FIRST WIRE FENCE - *SINCE* 1883

PAGE FENCE

offers you 4 METALS to choose from

Page Fence long ago had arrived at such excellence that the only way to give it a longer average lifetime was to vary the metal used in its construction according to local conditions of exposure. This, even, is now an accomplished fact. Page Fence comes in four different metals, selection being made according to local atmospheric conditions. Our fencing experts in your territory will be glad to advise you the kind of Page Fence that will give you the longest service.

1. Page Aluminum Fabric
(*Highly resistant to corrosion*)

2. Page Armco Ingot Iron Fabric
(*The purest and most uniform of all ferrous metals*)

3. Page Copperbearing Steel Fabric
(*Heavily galvanized after weaving*)

4. Page Ornamental Wrought Iron
(*The metal that serves for centuries*)

LINEPOSTS—*Tubular or* H *Section*

64 *service plants*

The Page Fence Association offers this highly personalized service to their clients. The selection and erection of a fence to perform the required duty and last the longest is not a job for the inexperienced or one to be undertaken lightly.

For that reason, Page maintains a staff of experts, distributed through 64 plants scattered throughout the whole country. These experts will assist you in the selection of the proper kind of fence for your purpose and will superintend its erection, thus insuring your satisfaction.

Page Service Plants maintain a permanent interest in your fencing. You are free to call upon them at any time. This is the policy that for forty-seven years has maintained Page's leadership in the fencing field. Write today for interesting literature and for name and address of distributor nearest you. Page Fence Association, 520 N. Michigan Ave., Dept. B35, Chicago, Ill.

▼

PAGE *America's first wire fence — since* STEEL AND WIRE PAGE QUALITY PRODUCTS 1883

Fence of Armco Ingot Iron fabric is exclusive with Page

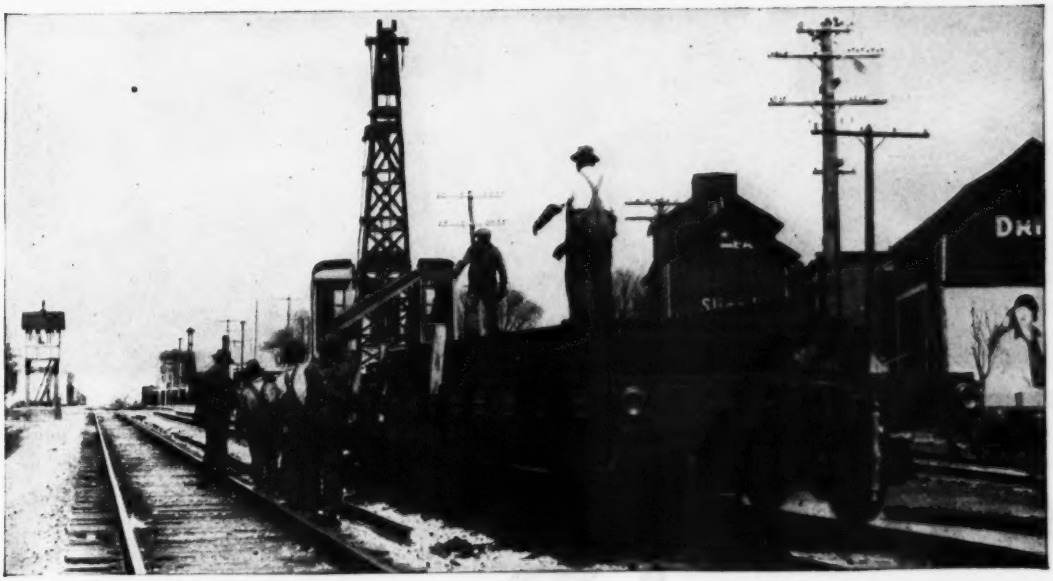
Page Fence is a Product of The Page Steel & Wire Co., an Associate Company of American Chain Co., Inc.

nation-wide service through 64 service plants

FENCE

AMERICA'S FIRST WIRE FENCE—*SINCE* 1883

Eliminate a work train by Burro Draw Bar Pull



Model 20 Burro Crane loading changed out rail on a car which the crane is hauling.

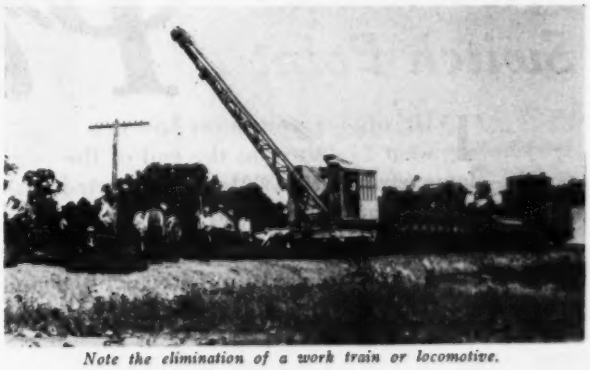
With draw bar pull of from 6,000 to 7,000 lbs. Burro Cranes frequently eliminate work trains or locomotives.

Out on the line Burro Cranes distribute new rail and pick up changed out rail hauling their own cars as well.

On new track construction Burro Cranes handle their own trains.

The Burro is an ideal yard crane, doing all its own switching as well as loading and unloading material.

The leading roads have used Burro Cranes in maintenance work for many years. How they use them is illustrated in an interesting bulletin—just write for a copy.



Note the elimination of a work train or locomotive.

Burro Cranes

REGISTERED U.S. PATENT OFFICE

CULLEN-FRIESTEDT COMPANY, 1300 S. KILBOURN AVE., CHICAGO, ILL.

Saves Switch Points — *because protector diverts wheel impacts and wear away from switch point ends*

This is an unretouched photograph. Note there is no wear on extreme end of switch point.

Mack Reversible Switch Point Protector

THE photograph shows how this simple economic device functions. No wear is shown on the end of the switch point. Long experience has demonstrated that "Mack" protected switch points are lasting ten times longer than the unprotected switch points.

There is no comparison between the cost of a switch point and that of the protector. They are quickly applied and the reversible feature means double wear for one price. They further act as a prevention against derailment, protecting both switch point and equipment.

The improved "Mack" Protector has edges beveled down to feather edge so that wheel flanges cannot contact metal at ends. The protector is made from highest grade manganese steel. Everyone is guaranteed to be perfect.

Manufactured by THE FLEMING COMPANY *Scranton, Penna.*

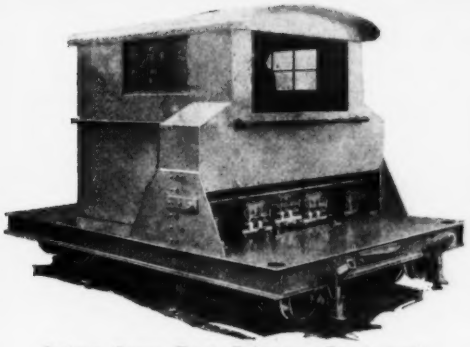
Patented in the United States and Foreign Countries

Exclusive Sales Agents for the United States

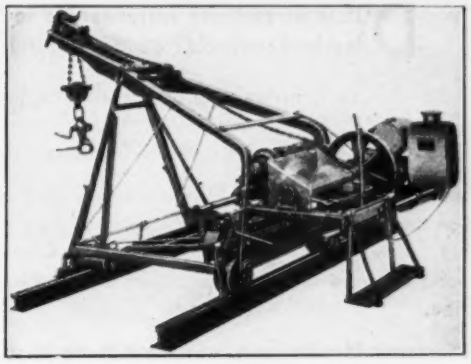
THE MAINTENANCE EQUIPMENT COMPANY

CHICAGO

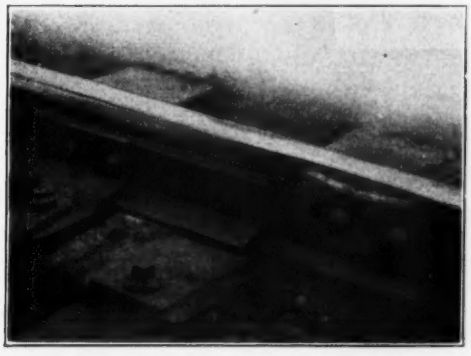
New York Cleveland San Francisco St. Louis



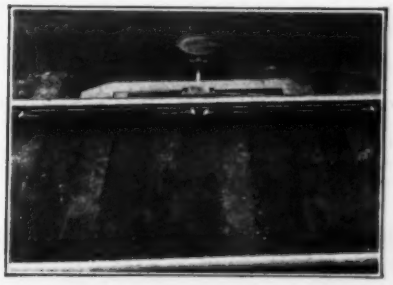
Jackson Power Track Ballaster. Speeds work. Every tie tamped firmly, uniformly.



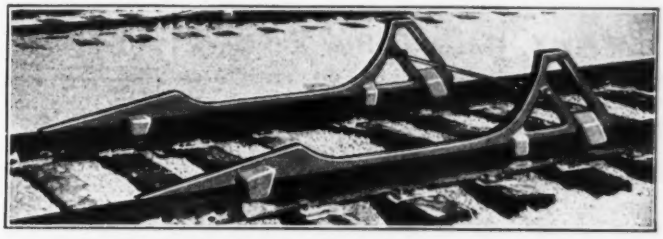
Power operated three-man rail layer.



Mack Reversible Switch Point Protector makes switch rails last 8 to 10 times as long as unprotected ones. Manufactured by The Fleming Company, Scranton, Pa.



Meco Rail and Flange Lubricator makes greater speeds possible with increased safety. Lengthens the life of the low rail as well as that of the high rail. Let us explain.



Breyley Friction Car Stops. Give 8 feet more stub track room.

Maintenance Equipment Company

LABOR SAVING TRACK DEVICES

RAILWAY EXCHANGE

CHICAGO

New York St. Louis Cleveland San Francisco Denver

Naylor SPIRALWELD Pipe

Combines the *Three* Requirements of a Dependable Carrier

DUE to its exclusive *spiralwelded* lock-seam truss, Naylor *Spiralweld* Pipe has a structure that provides

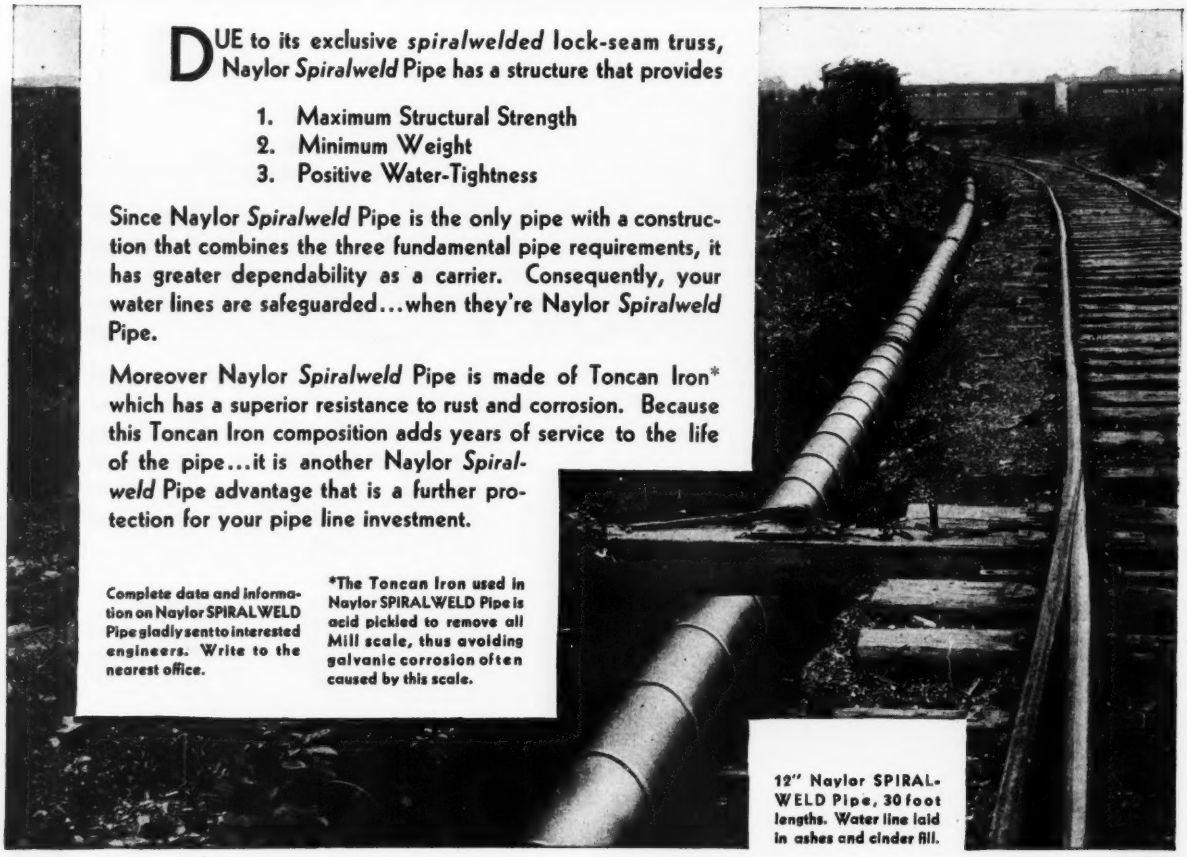
1. Maximum Structural Strength
2. Minimum Weight
3. Positive Water-Tightness

Since Naylor *Spiralweld* Pipe is the only pipe with a construction that combines the three fundamental pipe requirements, it has greater dependability as a carrier. Consequently, your water lines are safeguarded...when they're Naylor *Spiralweld* Pipe.

Moreover Naylor *Spiralweld* Pipe is made of Toncan Iron* which has a superior resistance to rust and corrosion. Because this Toncan Iron composition adds years of service to the life of the pipe...it is another Naylor *Spiralweld* Pipe advantage that is a further protection for your pipe line investment.

Complete data and information on Naylor SPIRALWELD Pipe gladly sent to interested engineers. Write to the nearest office.

*The Toncan Iron used in Naylor SPIRALWELD Pipe is acid pickled to remove all Mill scale, thus avoiding galvanic corrosion often caused by this scale.



12" Naylor SPIRALWELD Pipe, 30 foot lengths. Water line laid in ashes and cinder fill.

NAYLOR PIPE COMPANY, Main Office & Plant, 1230 E. 92nd St., CHICAGO

SALES OFFICES

3116 Chrysler Bldg. New York ◆ Witherspoon Bldg. Philadelphia ◆ 507 Philtower Bldg. Tulsa ◆ 2301 Commerce St. Houston ◆ 402 Petroleum Bldg. Ft. Worth

MONTREAL, CANADA: Mechanical Equipment Company, 660 St. Catherine St., West

TONCAN COPPER

Naylor Pipe

Maximum Structural Strength Mo-lyb-den-um With Minimum Weight

IRON

Standardized Naylor Pipe is made in sizes 6" to 12" I. D. and 14" to 20" O. D. in any uniform length desired up to 40'0". Ends made to wrought pipe standards for all types of coupling.

Toncan Copper Molybdenum Iron possesses a superior corrosion resistance, making it the favored pipe material.

Where corrosion is not a problem, Naylor Pipe can be furnished in steel.

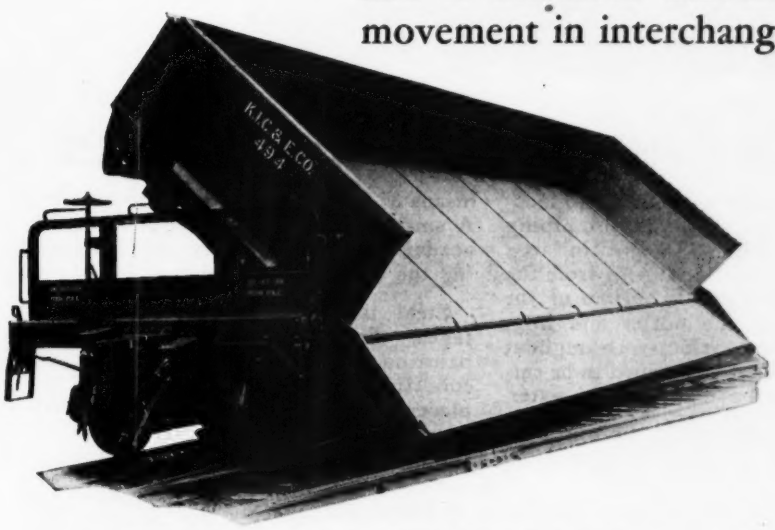
A NEW DEVELOPMENT IN AIR DUMP CARS

The Koppel 50 Cubic Yard RTD

Capacity 50 Cu. Yds. level—65 Cu. Yds. average heap load.

Large capacity makes it ideal for engine terminal use, for moving cinders and general refuse disposal.

Meets all A. R. A. and I. C. C. requirements and is therefore universally accepted for movement in interchange service.



Rapid discharge of load, free from excessive shock to car or track.

Simple and positive door operating gear, fully protected from falling rocks, etc., yet acceptable for inspection.

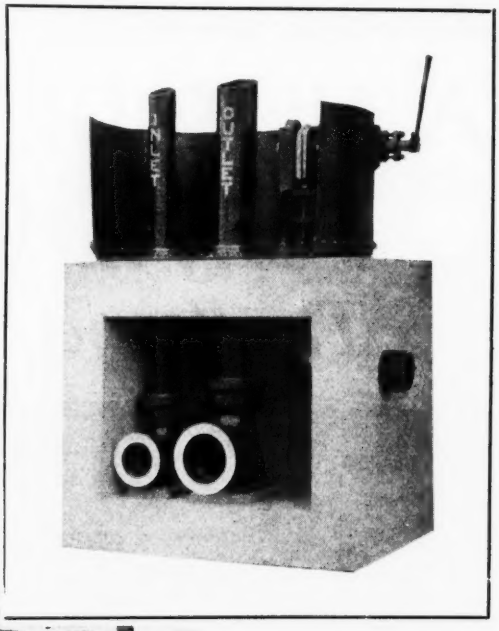
The door gear will not be damaged if the door strikes a boulder or other obstruction along the track in moving to dump position. Under such conditions the door is free to stop in its movement while the body continues to move full dumped position.

TRADE MARK REGISTERED KOPPEL U. S. PATENT OFFICE

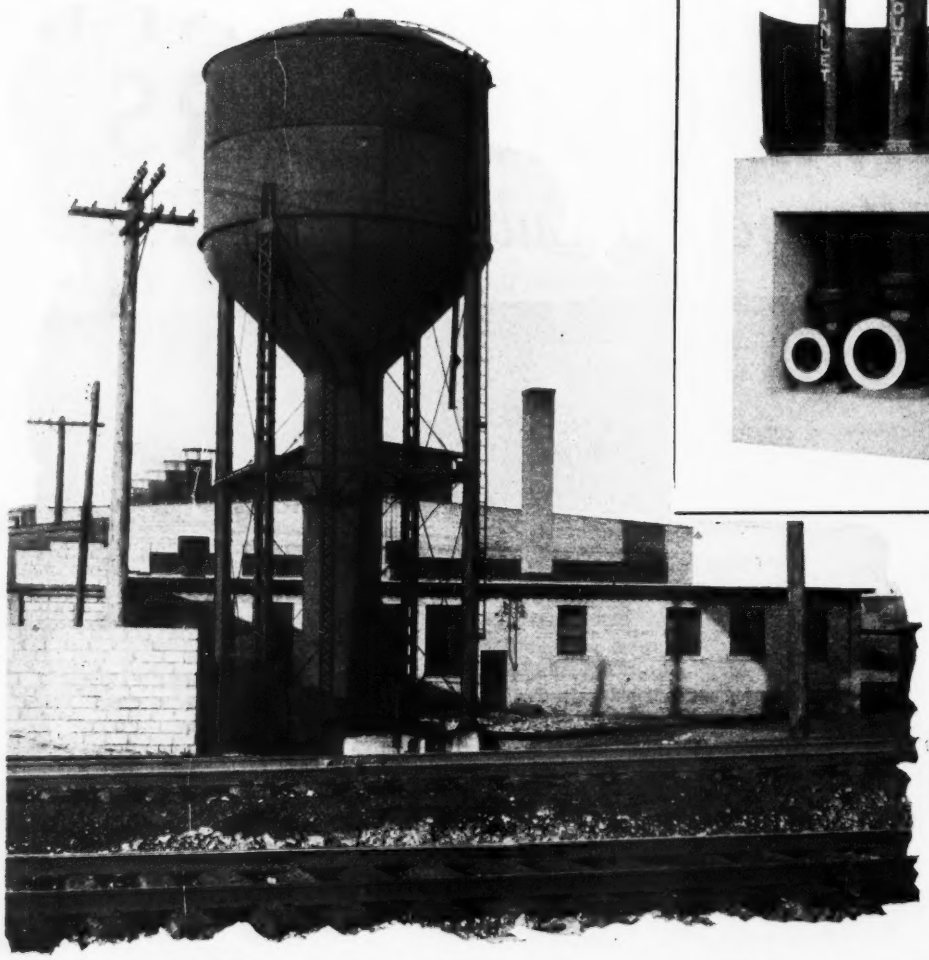
KOPPEL INDUSTRIAL CAR & EQUIPMENT COMPANY

KOPPEL, PENNA.

Sales Offices:
NEW YORK
PITTSBURGH
CHICAGO



Above: Cut away view showing piping connections and washout valve in bottom of steel tank riser.



Left: Conical-bottom steel tank used by the Illinois Central Railroad for roadside water delivery service.

Steel Tanks Deliver Clean Water

Steel tanks deliver clean water to locomotives because of the special piping arrangement which can be used in large diameter riser pipes. Sediment from the water accumulates in the bottom of the riser pipe, below the outlet and inlet pipe. It is not re-distributed throughout the tank when water is pumped in or carried out when a locomotive takes water.

Sludge collecting in the bottom of a steel tank riser is easy to remove by means of a quick-opening washout valve. A small amount of water will flush the accumulation out quickly, without taking the tank out of service.

Steel tanks also have other advantages. They are long lived. Regular painting will keep them in first class condition at all times. Repairs and replacements are seldom necessary. Ask our nearest office for quotations on installations contemplated on your road.

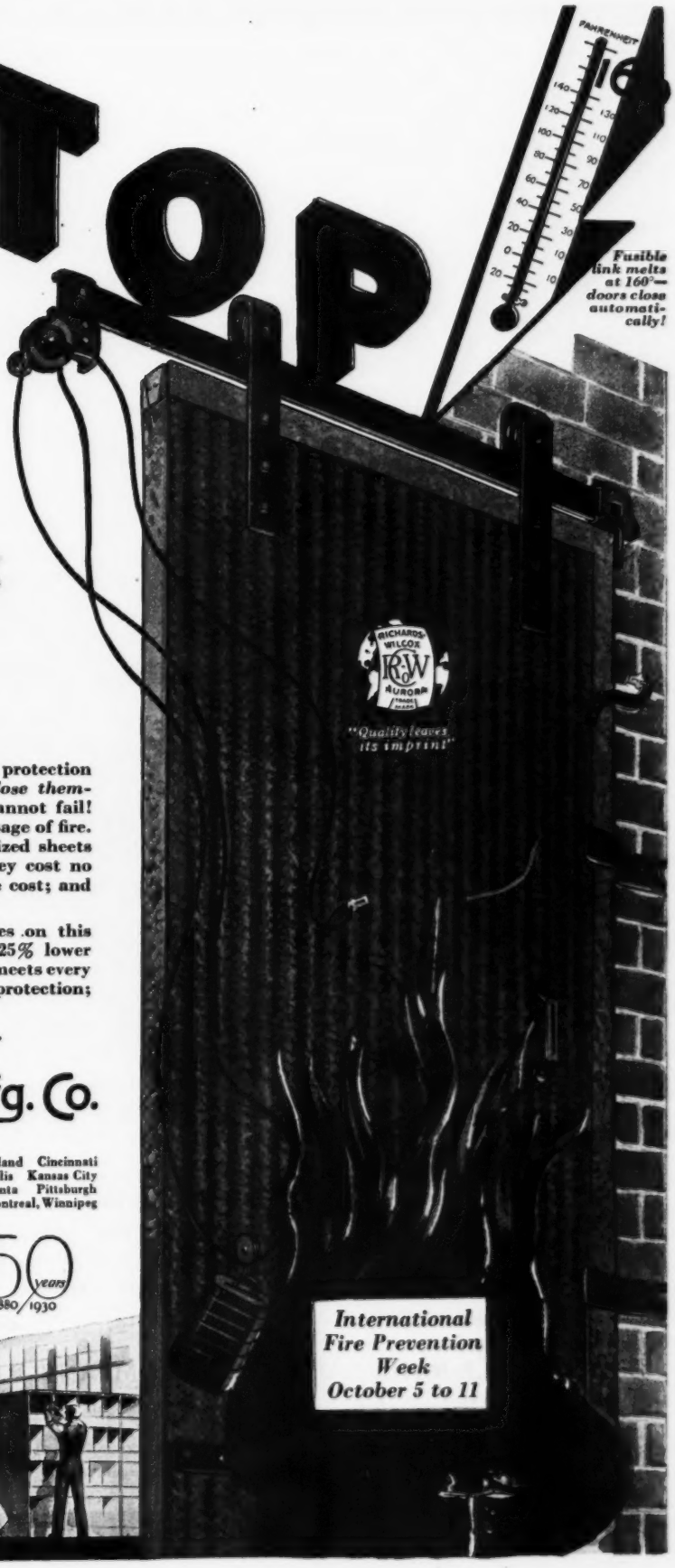
CHICAGO BRIDGE & IRON WORKS

Chicago	2452 Old Colony Bldg.	Houston	1125 Electric Bdlg.
New York	3156 Hudson Terminal Bldg.	Detroit	1519 Lafayette Bldg.
Cleveland	2202 Union Trust Bldg.	Philadelphia	1609 Jefferson Bldg.
Dallas	3309 Magnolia Bldg.	Atlanta	2136 Rhodes-Haverty Bldg.
Birmingham	1546 50th Street N	San Francisco	1007 Rialto Bldg.
Tulsa	2401 Exchange Bank Bldg.	Boston	1522 Consolidated Gas Bldg.

B-174

HORTON TANKS

STOP the FIRE with R-W AUTOMATIC Fire Door Equipment


FAHRENHEIT
Fusible link melts at 160°—doors close automatically!
RICHARDS WILCOX R-W AURORA
"Quality leaves its imprint"
International Fire Prevention Week October 5 to 11

Automatic closing . . . that's the certain protection afforded by R-W equipment. The doors *close themselves* at any temperature desired; they cannot fail! When closed, FyeR-Wall doors stop the passage of fire. Constructed with heavy corrugated galvanized sheets with thick sheet-asbestos between, yet they cost no more than tin-clad doors. No maintenance cost; and *guaranteed for 25 years!*

The label of the Underwriters Laboratories on this R-W equipment entitles you to 15% to 25% lower insurance rates. R-W Fire Door Equipment meets every conceivable condition; provides certain protection; brings tangible and important economies.

Consult an R-W engineer; write for catalog.

Richards-Wilcox Mfg. Co.

"A HANGER FOR ANY DOOR THAT SLIDES"
AURORA, ILLINOIS, U.S.A.

Branches: New York Chicago Boston Philadelphia Cleveland Cincinnati Indianapolis St. Louis New Orleans Des Moines Minneapolis Kansas City Los Angeles San Francisco Omaha Seattle Detroit Atlanta Pittsburgh Milwaukee Richards-Wilcox Canadian Co., Ltd., London, Ont., Montreal, Winnipeg

Note rigid construction of Fye-R-Wall doors with heavy steel frame. They cost no more than tin-clad doors.

50 years 1880/1930

Halve the number of Rail Joints by OXWELDING

USE of oxwelding to double-lengthen standard 39- or 33-ft. rail halves the number of rail joints and lowers track maintenance costs.

Oxwelded joints are as strong as the rail itself. They will not chip, batter, or work loose. Even when there is rail creepage, the ties under them are not injured. Once made, an oxwelded joint is permanent. For economy and efficiency, there is nothing superior.

Your own employees can be trained to make oxwelded joints. The Oxweld Railroad Service Company will teach them correct welding methods, supply apparatus and materials, and supervise operations. A majority of the Class I railroads have been contracting for this service for 18 years.

OXWELD RAILROAD SERVICE

THE OXWELD RAILROAD SERVICE COMPANY

Unit of Union Carbide and Carbon Corporation

NEW YORK
Carbide and Carbon Bldg.

UCC

CHICAGO
Carbide and Carbon Bldg.

The ARMCO *Jacking Method*

Reduces Labor Costs . . . and Avoids Track Settling . . .

INSTALLATION of culverts through fills by the Armco Jacking Method is costing railroads but a fraction of the expense of open trenching. Savings run from 30 to 50 per cent. Under average conditions the operation through a fill requires the time of only a small crew, obtainable locally.

This important economy is, however, only the first reduction in costs effected by this revolutionary improvement in methods. Armco Jacking does not disturb the roadbed—has no influence on the foundation. So there can be no settling of the track—no endangering of the fast-rolling, heavy traffic overhead.

And what is more, the great strength, flexibility and durability of Armco Corrugated Iron Pipe assure an installation that will serve faithfully for the decades. This Nature-tested product with a service record of 24 years to date has no equal for endurance, and is unaffected by conditions which often spell ruin for ordinary culverts.

Without special equipment, without disturbance to traffic, at small cost for years of maintenance-free service, jack through with Armco Corrugated Iron Pipe. Complete information on the Armco Jacking Method, a development of Armco Engineers, together with data on its use, will be sent on request.

Armco culverts and drains are manufactured from the Armco Ingot Iron of The American Rolling Mill Company and always bear its brand

ARMCO CULVERT MANUFACTURERS ASSN., *Middletown, Ohio*

© 1930, A.C.M.A.

WIDELY USED BY RACOR SWITCH OPERATING CONDITIONS

Ramapo Automatic Safety Switch Stand Style No. 20-B

The Ramapo Automatic Safety Switch Stand incorporates an automatic safety feature which makes it impossible to damage either the stand or the switch points if trailed through when set in closed position. This protection is of extreme importance in busy yards.

This switch stand is designed to work manually as a rigid hand-thrown device, with ample strength for the heaviest requirements. The safety device is part of the base mechanism, consisting of a star block and heavy springs, which in turn revolve the spindle carrying the target. The target always indicates the actual position of the switch points. The stand is always left ready for normal hand throw.

So successfully does this stand operate, so completely does it eliminate accidents and maintenance, so effectively does it speed up work that over 300,000 are in use on leading American railroads.

Racor Parallel Throw Gearless Switch Stand Style XL-36

Wherever a low rigid switch stand is specified the Racor XL-36 Gearless Switch Stand is recommended. Unlike any other switch stand of the low rigid type, the XL-36 meets requirements incident to dependable, low-cost and efficient operation. It is simple and ingeniously designed.

There are only three operating members—the spindle, the shaft with its operating handle, and the rotating disc or roller—all made of rolled or forged treated steel. Gears are eliminated, and also the undesirable features and parts which cause practically all the trouble with ordinary types of low rigid switch stands.

The operating parts are all machined to accurate fit with each other and with the stand housing, thereby reducing lost motion to a minimum. With bearing surfaces amply large throughout, wear becomes almost negligible in the ordinary sense as experienced in similar installations of the old types of rigid switch stands.

Its durable construction, dependability and service make the Racor XL-36 gearless switch stand an appliance which assures efficiency and economical maintenance.

LEADING RAILROADS STANDS IMPROVE WHEREVER INSTALLED

The New Racor Three-in-One Switch Stand

Wherever the maintenance of one position of switch points is desired, as at the end of a double track, the Racor Three-in-One Switch Stand will eliminate the expense of stopping trains for the purpose of throwing a switch or the cost of maintaining an operator at such a switch or expensive mechanical equipment for throwing it from a distant tower. It is a big factor in reducing operating costs at such switches. It maintains an interrupted routine schedule of train movements; safeguards equipment at these locations and promotes economies in lowered installation and maintenance costs.

This new Racor Three-in-One Switch Stand provides in one housing all the desirable features of three separate units.

(1) A RIGID SWITCH STAND for free hand operation in either direction. The hand lever is rigidly connected with the switch points which must be fully thrown before the switch stand can be latched or locked. The target always indicates actual position of the switchpoints whether open, closed or in danger position (partly open).

(2) AUTOMATIC RETURN. Two springs housed in switch stand base, independently connected with switch stand spindle through roller bearings, either of which springs could automatically return trailed switch points to original position when set against train movement.

(3) RETARDED RETURN. An adjustable oil cylinder (an integral part of the stand mechanism) is housed in the base. It does not retard the automatic opening of the switch, but the return action IS retarded positively and gradually under ressure control. The switch remains open until the last of wheels has passed, when it will be returned, as may be desired, until nearly home, and then iginal position.

Service stand nine in the manu- of rail-

RAMAPO AJAX C

RACOR PACIFIC FROG AND SWITCH COMPAN

CANADIAN RAMAPO IRON WORKS, LIMITED, Niagar

General Offices – 230 PARK AVENUE, NEW YORK

SALES OFFICES AT WORKS, AND
McCORMICK BUILDING, CHICAGO
METROPOLITAN BANK BLDG. WASHINGTON
BUILDERS EXCHANGE BLDG. ST. PAUL

Nine Racor Works

Hillburn, New York. Niagara Falls, N.Y. Chicago, Illinois, East St. Louis, Ill.
Superior, Wis. Pueblo, Col Los Angeles, Cal. Seattle, Wash. Niagara Falls, Ont.

No. 22 of a series

PUBLISHER OF
RAILWAY AGE
RAILWAY MECHANICAL ENGINEER
RAILWAY ENGINEERING AND MAINTENANCE
RAILWAY ELECTRICAL ENGINEER
RAILWAY SIGNALING
MARINE ENGINEERING AND SHIPPING AGE
THE BOILER MAKER

Railway Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

"THE HOUSE OF TRANSPORTATION"

PUBLISHER OF
LOCOMOTIVE CYCLOPEDIA
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MAINTENANCE CYCLOPEDIA
BOOKS ON TRANSPORTATION SUBJECTS

NEW YORK 30 CHURCH STREET | CHICAGO 105 WEST ADAMS ST. | CLEVELAND 50 PUBLIC SQUARE | WASHINGTON 17TH AND H STS. N.W. | SAN FRANCISCO 215 MARKET STREET

ADDRESS REPLY TO
105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Are Advertisements Read?

September 25, 1930

Dear Reader:
Everywhere

Not infrequently I am asked by a reader if the advertisements published in our columns are read by the busy railway man. Since the same question has probably occurred to you, you may be interested in an incident that came to my attention a few days ago.

I was lunching with the advertising manager of a prominent railway supply company and the chief maintenance officer of an important railway, with the conversation touching on baseball and other sports of the day. Suddenly the advertising manager, who is a regular and liberal user of our advertising pages, changed the conversation abruptly with the comment:

"Howson, Railway Engineering and Maintenance is certainly read."

"I know that to be a fact," I replied, "but what has caused you to draw that conclusion?"

"I know, because of the number of inquiries we get for our equipment that are directly traceable to advertisements in your paper," he replied. "To be specific," he continued, "we received an inquiry for a device so advertised from the maintenance officer of a railway in a foreign country in which we had no sales representation. This inquiry led to a nice order, but even more important for us, however, it led to an investigation on our part which uncovered a market sufficiently large to cause us to establish a sales agency there which has since taken over also the sales of the products of several of our affiliated companies. This apparently innocent inquiry has thus led to what will undoubtedly be a permanent and profitable sales outlet for several of our companies."

This incident is not unique, for others come to our attention at frequent intervals. We realize, also, that we hear of only a relatively small proportion of all such cases. It may not be without significance in this connection that 28 of the 78 advertisers in this issue were in the corresponding issue 10 years ago.

Yours very truly,

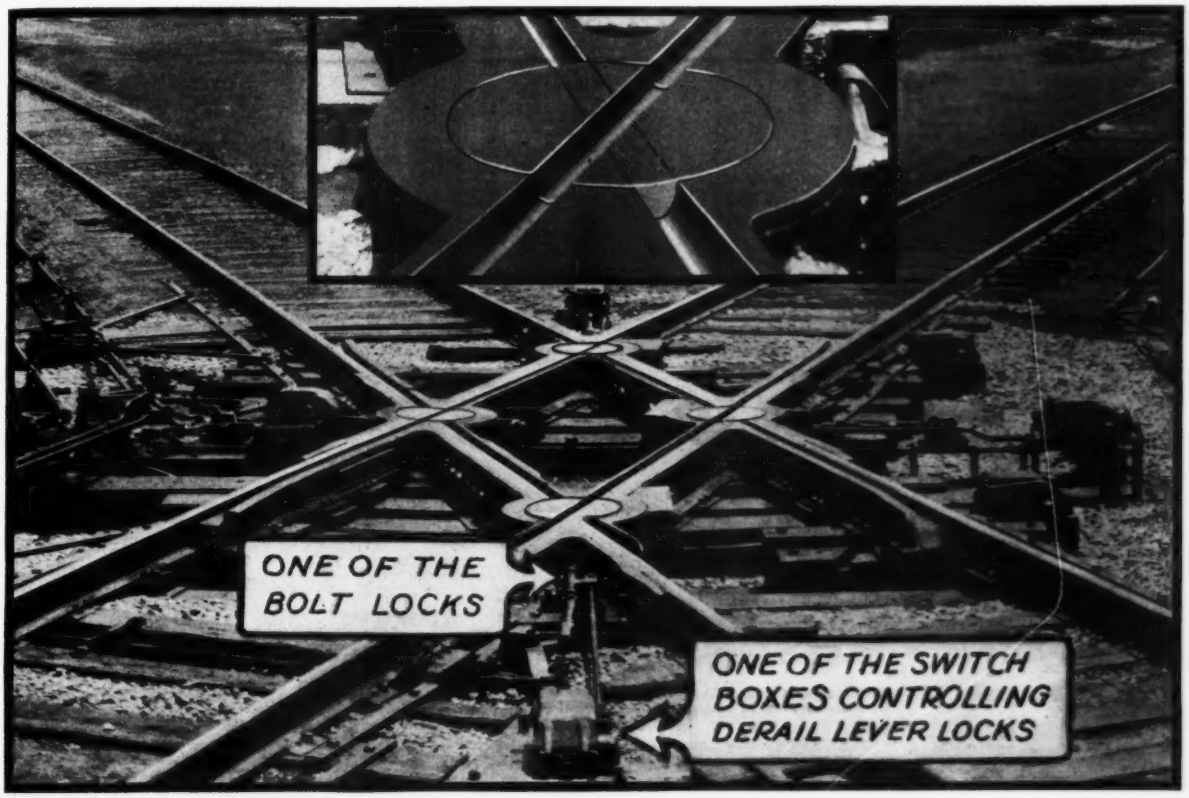
Elmer T. Howson

ETH*MM

Editor.

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

Whalen Shockless and Noiseless Crossing



Photograph of recent installation at junction of Union Pacific and Southern Pacific at Los Angeles, Calif.

SAFETY and ECONOMY

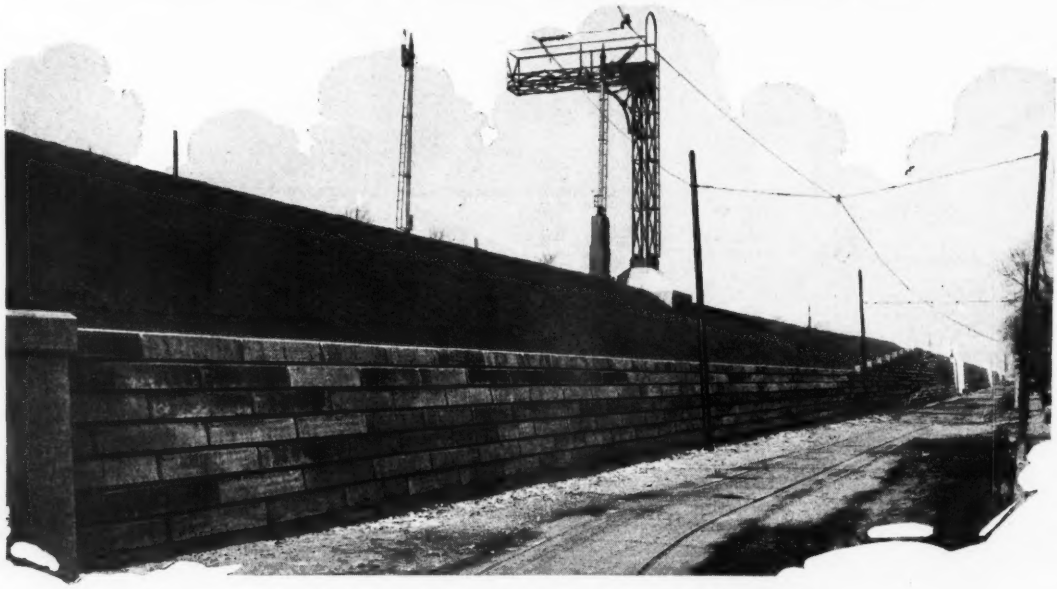
The WHALEN SHOCKLESS AND NOISELESS CROSSING consists of a manganese steel casting with a cylindrical well at the intersection of each two rails. Into these wells are fitted chrome vanadium turntables, with single flangeways in the upper surfaces. These turntables are operated either manually, under the protection of a standard interlocking plant, or electrically, under the same protection.

The turntables provide a "continuous" or unbroken rail in either direction (see illustration), eliminating the flangeway gap, thereby producing a noiseless and shockless crossover. The elimination of shock materially reduces the cost of maintenance of rolling stock, of the crossing itself, and of the foundations.

Our engineers, who are experienced in practical, modern railway operation, will gladly furnish detailed information and complete specifications on request.

CONTINUOUS RAIL CROSSING CORPORATION
SHOCKLESS NOISELESS CROSSINGS
323 PACIFIC ELECTRIC BUILDING
LOS ANGELES, CALIFORNIA

—no maintenance
ON THIS RETAINING WALL



Retaining wall erected by the Grand Trunk at Chicago, one of a large number of walls of Federal 2-piece construction installed by this road over a period of many years.

FEDERAL 2-piece Concrete CRIBBING

This *closed face* construction has brought about a distinct advance in retaining wall design.

A one-inch continuous slot between face members provides free drainage—*there are no other openings in the face of the wall.* Backfill cannot filter through—there is no need to chink up openings—to clean up or renew fill.

The attractive masonry-like appearance of this wall makes it highly desirable for any right-of-way. Two-piece design in addition provides a permanent, heavy duty wall—saves material and erection costs—allows speedy installation in any weather. There is 100% salvage if the wall is moved.

Booklet, on request, shows many installations for prominent railroads, as well as for industrials and highway projects.

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608 South Dearborn Street Chicago, Illinois

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Railway Engineering and Maintenance

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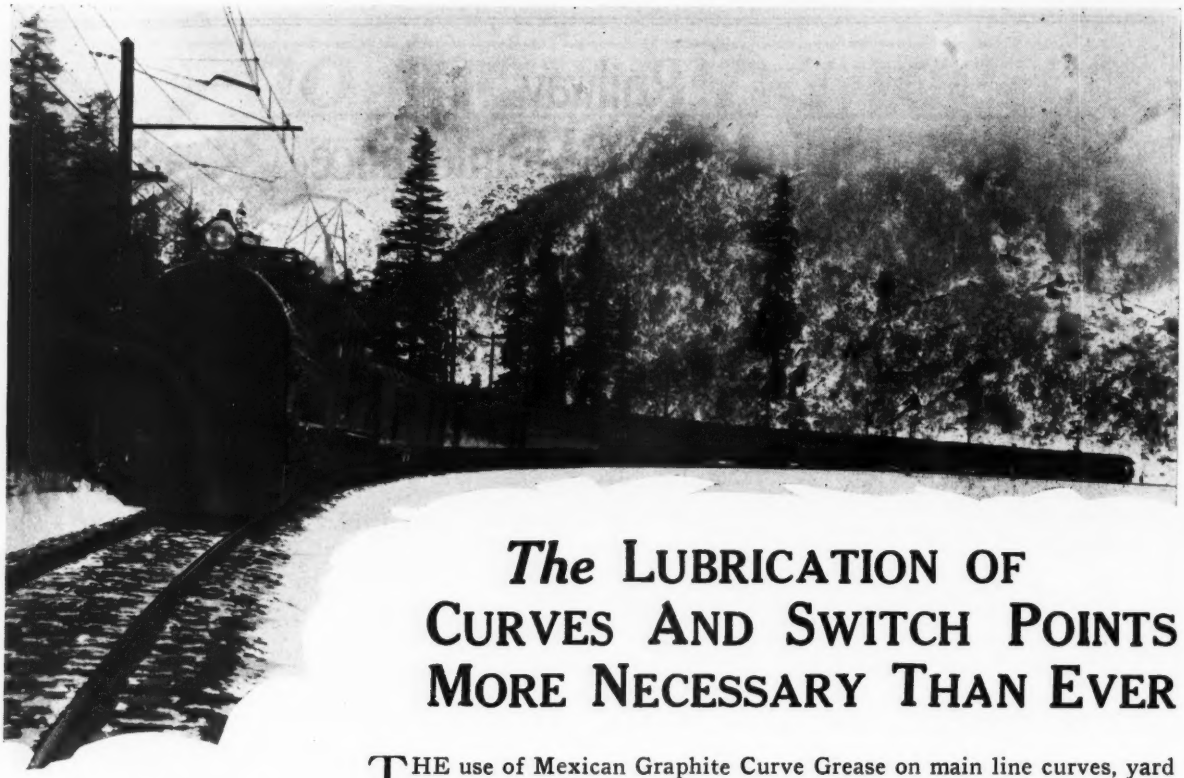

The LUBRICATION OF CURVES AND SWITCH POINTS MORE NECESSARY THAN EVER

MEXICAN GRAPHITE

Curve Grease Saves Rails and Switch Points

THE use of Mexican Graphite Curve Grease on main line curves, yard leads and switches, is one big step toward economy.

This effective lubricant makes certain big dollar and cents savings. It reduces the expenditure for rails and switch points by making them last longer. Furthermore, the maintenance labor costs are reduced because replacements and track disturbances are minimized.

Mexican Graphite Curve Grease has demonstrated that it is the most satisfactory lubricant for use on rails and switch points. It is manufactured in consistencies for every type of automatic lubricator and for hand application. The fine powdered graphite enters the pores of the steel, assuring a friction-free surface which continues to lubricate long after the grease has disappeared. Rain, sleet and snow will not impair the efficiency of this effective grease. It sticks and sticks and sticks on the rail.

Apply Mexican Graphite Grease for permanent economies.

The United States Graphite Company

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Railway Engineering and Maintenance

Volume 26 October, 1930 No. 10

Nearly a Half Century Old

THE FACT that the meeting of the Roadmasters' and Maintenance of Way Association reported in this issue is its forty-eighth annual convention should be reason enough for serious consideration of preliminary plans for the semi-centennial convention of 1932. Surely a record of 50 years of valuable service to the railways of America is one that may well be dignified by suitable exercises at the fiftieth annual convention. Such a celebration would serve as a means of drawing emphatic attention to the fact that the Roadmasters' Association is the oldest organization in the roadway and structures department, its origin antedating that of the Bridge and Building Association by nine years and the inception of the Engineering Association by 17 years.

Until the A. R. E. A. was brought into being, the Roadmasters' Association constituted the only body of railway men that was exerting any organized effort to promote improvement and greater uniformity in the conduct of track maintenance. In fact, with the exception of the work done by the American Society of Civil Engineers in connection with the development of a standard rail section, no other organization was giving any consideration to standards of track work. In a certain measure, at least, the activities of the Roadmasters' Association within the limits of its own field pointed the way to a broader field of usefulness of an association of railway engineers, which eventually took the form of the A. R. E. A., organized in 1899. It is true that some roadmasters harbored serious misgivings as to the effect of this new association on their own organization. But these fears proved ungrounded, as the A. R. E. A. has carefully avoided interference with the prerogatives and field of usefulness of the Roadmasters' Association. As a result, the older association has continued to prosper and, especially during the last 15 or more years, has made remarkable progress and enjoyed a reputation in keeping with its place as the senior among associations of officers concerned with the fixed properties of the railways.

RAILWAY EMPLOYMENT*

In June of this year the number of railway employees totaled 1,564,269. This was 172,000 less than in the same month last year and 217,500 less than the average for this month during the last five years. While this is due in part to the present depression in business, it is even more largely the result of the diversion of traffic to other agencies.

The passenger earnings of the railways this year will be about $525,000,000 less than in 1920, owing to the competition of motor vehicles on the highways. Their freight traffic increased only one-fourth as much annually during the nine years ending with 1929, as in the preceding ten years, as a result primarily of the competition through the Panama canal, on the inland waterways and by motor trucks. It is principally because of this diversion of traffic to government-subsidized agencies that the number of railway employees has been declining.

How long will these employees continue to accept without protest public policies which are tending to deprive them of their means of livelihood?

*From an address by Samuel O. Dunn, editor of the Railway Age, before the Equipment Painting section of the American Railway Association on September 10.

Safety in Switch Work

THE installation or renewal of turnouts has always required the employment of experienced foremen who are skilled in this class of work. Certain of the hazards that attach to such installations are common to other forms of track work while others are peculiar to it. Furthermore, owing to the number of men who are required to work in a limited space, some of these hazards are intensified, so that certain parts of the work are more prolific of personal injury than others.

It has been found that accidents occur more frequently to the tongmen, the bolters and the spikers and, to a slightly less extent, to the spike-pulling group and the men who are engaged in throwing out the old rail and removing the tie plates and other parts. The handling of spring frogs for heavy section rail is the most hazardous operation in renewing a turnout although the risk can be diminished to a considerable degree if a crane of ample capacity is used to handle the frogs, switches, guard rails, etc., and to lay the rail.

Some of these hazards, such as handling the frogs, switches and rail by hand are intensified with the increase in the weight of rail. Others, such as those involved in pulling spikes, removing tie plates and other parts,, and spiking are influenced to a limited extent, if at all, by changes in the section of the rail.

The most important action that can be taken to promote safety in work of this character is to assign to it a capable experienced foreman who is skilled in this class of work. Many foremen who are otherwise rated as high grade men never acquire the ability to do a first class job of switch work, and gangs in their charge usually have a high accident rate. In addition to his ability to assemble the sev-

eral parts of a turnout properly, such a foreman must organize his gang to minimize the interference of one unit with another. He must be alert to see that the men do not put themselves or others in danger.

To insure the highest degree of safety requires careful advance planning of all of the details, a schedule of the sequence of the various operations and intensive supervision. If this is done and the foreman is watchful, the work will be carried out expeditiously as well as safely.

The Importance of Water Service

A REPORT prepared in 1914 by the Committee on Water Service of the American Railway Engineering Association on current progress in water-softening practice presented an outlook that was far from encouraging for the future of roadside water treatment. This, it will be remembered, was about ten years after the real beginning of roadside water treatment on American railways. But the committee found that a while number of roads were operating water-treating plants, the treatment of water in such plants was generally unpopular and those who advocated the construction of new water-softening facilities received little encouragement. Almost no new plants had been built for several years and a number of those previously constructed were no longer in service.

The committee's investigation into the reasons for this situation led to the conclusion that while there had been errors of judgment in the construction of plants, because of lack of experience in this field, the primary cause for the prevailing dissatisfaction with respect to these facilities arose from a rather general failure to appreciate the need of adequate supervisory control. Water treatment, like the general problem of water supply, was at that time anybody's or nobody's business. Few roads at that time maintained any specific water-service organization or provided any particular officer whose primary duty it was to study problems of water supply and treatment or to exercise supervision over water-service activities. By way of illustration, the Committee on Water Service, as constituted in 1914, consisted of 10 men, only two of whom were at that time occupying positions concerned exclusively or primarily with water supply or water treatment.

In following up its conclusions as to defects in the operation of water-treating plants, the committee offered some specific recommendations for their supervision, chief among which was one providing for the creation of the position of superintendent or supervisor of water service. That this recommendation produced results is well known for one railway after another effected arrangements for a more thorough supervision of its water-supply operations. But no better demonstration of this is to be had than that offered by a comparison of the personnel of the A. R. E. A. Committee on Water Service and Sanitation as it is now constituted with that of the corresponding committee of 1914. Instead of 2 water-service men out of 10, the committee now has 44 members, 37 of whom are now, or have been in the past, engaged either in the direct supervision of water-service work or concerned in problems having to do with that department.

It is doubtful if any phase of railway organization has undergone so remarkable a development in a corresponding period. The nearest approach to it is that growing out of the increased use of labor-saving equipment and leading to the creation of the position of supervisor of work equipment. But developments in water supply definitely antedated that in power appliances and, in a measure, have shown the way for better organization in the newer field. Water service now has a definite status as a subdepartment on nearly all railways and with this recognition have come better water supplies of greater reliability.

With a more thorough knowledge of their subject, water supply officers have been able to secure authority for new facilities entailing expenditures of a magnitude that was formerly undreamed of in this field. They have also been able to stress the importance of good water and institute measures to obtain it, whether through the use of treating preparations or the construction of softening plants.

Value of Association Membership

A QUESTION which has been raised in the minds of many railway men may be worded about as follows: Is a railway supervisory officer, without membership in the association or associations of his calling, as well equipped and as valuable to a road as another engineer or supervisory officer with the same qualifications and experience, but who is a member of the association or associations of his fellow workers?"

The value of railway associations is recognized in a general way, and there are few roads that do not appreciate their employees taking an interest in such organizations. The above question, however, inquires specifically whether a man without association membership stands as high with his employer and supervisory officer; does he stand as much chance of promotion, and if he is unemployed, does he have as much chance of obtaining work as another man of equal experience and general qualifications who, in addition, has association membership?

An unusual amount of light on this question is given in the answer to a more or less similar question propounded to members of the Western Society of Engineers, Chicago, through the bulletin of that organization. This question, given below, was preceded by the following explanatory statement:

"An employee of the firm A. B. C. & Co., has represented himself as fully equipped to undertake the work assigned to him. He has a drafting set, slide rule, some textbooks and handbooks, and also a considerable amount of experience, but he does not have, in his own right, membership in the Western Society of Engineers. Is this engineer as fully equipped as another engineer having identical experience, qualifications and tools, and who is a member of the Western Society of Engineers?"

Many illuminating answers were received to the question, over 90 per cent of which were outspoken in their negative assertions. "No, he is not as fully equipped—." "No, he has not taken advantage of the possibilities of wider acquaintanceship and further knowledge offered to him through the activities of the Society." "No, he lacks prestige and the advantage of contact." "No, unless in financial distress—." "No, never as fully equipped." "No. If two men apply for a position in my office, both showing the same equipment, education and experience, and one of them a member of the Society, the preference would be given to the Society man, whether or not I were a member of that organization.

The above statements, taken at random from the large number of answers received, convey the prevailing attitude of engineers, including railway engineers, toward

the value of association membership, and, as specific statements of fact, should not be overlooked lightly by any man who is interested in his own welfare and that of the company by which he is employed or expects to be employed. The answers establish as fact the feeling that a man active in the association or associations of his fellow workers is not only more valuable to his company, but that he has a better chance of advancement and a better chance of employment if out of work than a man not interested in association work. While the first two of these considerations should be always in the minds of railway employees, regardless of rank, the latter consideration, in view of the present condition of the railways as well as other lines of industry and commerce, concerning employment, might well be given serious thought also.

Tie Economy

DATA compiled by a joint committee of the American Railway Engineering Association and the American Wood Preservers' Association covering approximately 200,000 miles of maintained track, show that the average number of crossties renewed per mile of such track has declined from 259 in 1916 to 183 in 1929. In other words, in this period of 13 years, the requirements of approximately half the mileage in the United States have decreased 76 ties per mile of track, or nearly 30 per cent. This indicates a present annual saving for these roads of more than 15,000,000 ties, and for all of the roads in the United States and Canada of at least twice that number. Such a record constitutes an economy of the first magnitude and one that should be a source of gratification to every maintenance of way man, and particularly to those railway officers who pioneered in advocating the treatment of ties.

Yet there is another phase of this problem which is not so gratifying. If one analyzes the statistics for the individual roads that enter into the totals mentioned above, he will find that these figures vary from 74, 86 and 91 ties renewed per mile of maintained track (five year averages) at one end of the line to 249, 274 and 278 at the other extreme. In other words, the average renewals for the three high roads in a period of five years was more than three times that for the three low roads. This shows that in spite of the progress that has been made to date, there are still greater possibilities ahead, and that for most of the roads the success attained so far is of value primarily as an incentive to still greater efforts.

If all of the roads should reduce their renewals to only 100 per mile within the next few years, they would effect a saving in their present tie requirements of more than 30,000,000 ties. That this is not an idle suggestion is shown by the fact that several roads have already brought their average renewals for the last five years well below this figure.

Such a result can be achieved, however, only by the adoption of those measures which have proved so effective with the roads that are now enjoying minimum renewals. The first and foremost of these measures is, of course, adequate treatment of all of the ties used. The merit of this practice is becoming so generally recognized that argument is no longer necessary, although one can yet find a few roads that feel that they can still afford to use untreated ties.

Treatment, however, is not enough. The ties must be of sound timber, of adequate size, and well made and must be so protected against abuse after treatment as to make the treatment most effective. This includes the adzing and boring of ties before treatment, the universal application of tie plates of proper design and adequate size, the reduction of spiking to the minimum and other more or less obvious precautions.

Most important of all is the instilling into the minds of track men the thought that a tie is a unit of property that should not be abused, rather than merely a stick of timber that can be replaced at will. When this attitude becomes universal, what is now the largest single item of maintenance expenditure, will be cut almost in half, and ties will attain a life of 30 years or more, comparable with that commonly found in Europe and approached on a few roads in this country.

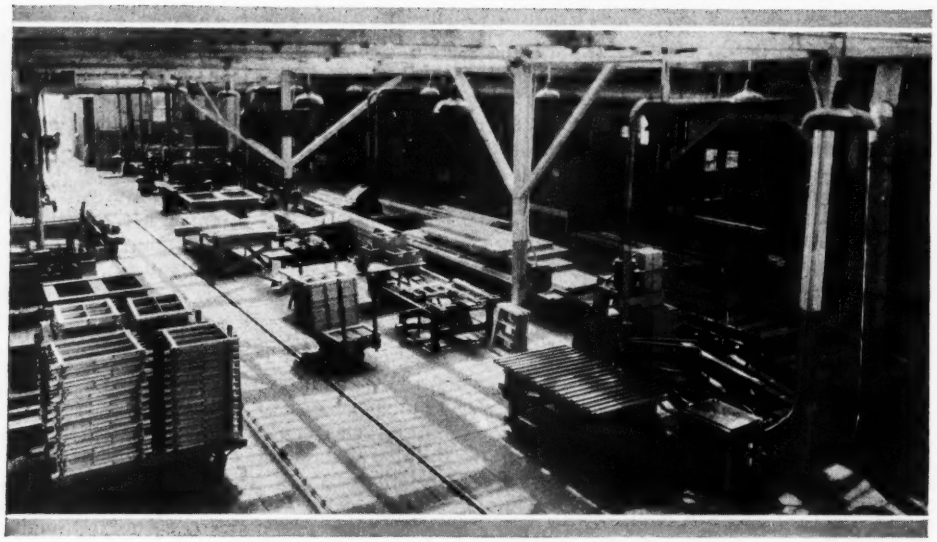
Speed Versus Quality

IN THE course of a track inspection made for the purpose of studying a rail-renewal program, attention was centered on one stretch of six miles of rail, because of its excellent condition after five years of service under heavy high-speed traffic. Its good condition in comparison with other stretches of rail of the same age could not be explained by any possible variations in circumstances, until the supervisor recalled that the extra-gang foreman who had laid this particular stretch of rail was a man who had a reputation for painstaking work and that he had been particularly proud of the job he had done on this piece of track.

The life of rail depends on a great many factors which it is unnecessary to mention here. However, given a section of track that is surfaced either immediately before or after the rail is laid and that receives subsequent attention in maintenance proportionate to the traffic it carries, the service that is rendered by that rail as compared with another section will be influenced appreciably by the quality of workmanship brought to bear when it is laid.

Leaving out of consideration the surface and line, for which the rail-gang foreman is ordinarily not responsible, there are five primary factors that affect the quality of a complete job of rail laying; namely, careul adzing, accurate gaging, proper application of the joints, uniform and accurate distribution of the expansion, and prompt and correct application of rail anchors. To state these conditions is simple enough; to see that they are carried out is another matter. Chief among the obstacles imposed is the difficulty of laying down any hard and fast rules or specifications for good workmanship whereby it is possible to state definitely what is and what is not the standard of quality demanded.

A good trackman can do good work and knows good work when he sees it, but it is difficult for him to state exactly what it constitutes. For this reason it is highly important that adequate precautions be taken when emphasizing high output per hour or per day, to insure that the quality of the work is not sacrificed. The relaying of rail costs money and the more rail that is laid per hour with a given force, the cheaper it will be done. However, the cost of relaying rail is, after all, relatively small compared with the investment in the new rail itself, and if the investment in the rail is to earn a maximum return, the material must be kept in the track as long as possible, which is an objective that cannot be attained if careless workmanship enters into the laying. That this principle is appreciated and further that quantity need not be secured at the expense of quality of workmanship, is shown by the examination of the rail laid by many of the gangs that are making most enviable records in output.



A View Within the Cabinet Shop Section of the Mill

Southern Pacific Precuts Lumber for

System mill produces ready-to-erect right-of-way structures and small stations as well as preframed material for bridges

BUILDINGS are cut to order and are shipped complete and ready to erect by the Southern Pacific, Pacific System, from its extensive lumber storage and wood-working facilities at West Oakland, Cal. These structures include company dwellings, section tool houses, small passenger stations, stock corrals, and water tanks up to 50,000 gal. capacity. The system of preframing in effect also includes material for bridges, trestles and other wooden structures for which this method is adapted. While many of the structures so cut and shipped are standard, not all of them come under this classification. The advantages of this system include reduced cost of erection, decreased waste of lumber and quicker completion of the structures.

Plan Simplifies Ordering

The precutting and framing of material for such buildings as section foremen's and section laborers' dwellings was started experimentally in 1927 in the hope of effecting economies and of making more intensive use of the facilities at the mill. Prior to that time it had been the practice to send detailed requisitions to the stores department for the necessary material to be sent to the points where these structures were to be erected and, when received, the material was cut and framed by division carpenter forces.

Under present practice, these buildings are ordered on requisitions sent to the stores department, which merely request that all material, with certain exceptions, be prepared in accordance with specified drawings and shipped to a definite place, in care of a specific person, on a certain date. The exceptions mentioned usually include cement, stone, sand, nails, paint and materials for plumbing and wiring.

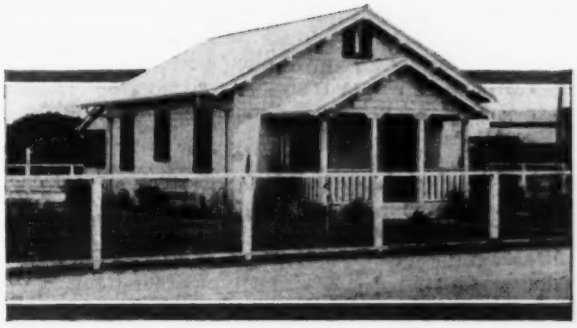
When such a requisition is received at the mill, a check is made to see that the latest drawing reference has been furnished for the type of building ordered, after which the requisition is then detailed in accord with a well-established routine of operations, whereby the work required is divided among the different sections of the mill, and finally the many pieces for the structure are assembled, checked and shipped together as a unit. In the first step, a list or bill of material is prepared from the drawings and each individual item is detailed, if this has not been done previously in connection with earlier orders for similar buildings. The various items included on the list are arranged in the sequence in which the parts or pieces will be required in the erection of the building, and are numbered consecutively to avoid confusion.

Follow an Established Routine

When the list has been checked carefully, a number of typewritten copies are made. The original is furnished to the assembly foreman at the mill, who uses it in ordering and assembling rough and finished

hardware, roofing and similar materials on which no shop work is required. One copy is forwarded immediately by mail to the consignee; another copy is furnished to the mill machine operators to facilitate the laying out of their work, and still another copy is retained at the mill for an office record. A fifth copy of the list is held at the mill office and is forwarded to the consignee in the car with the material ordered.

After the list has been completed, shop bills and requisitions are prepared for all materials on which shop work is necessary, and the preparation of these materials is started. Lumber taken from stock is brought into the mill on wheeled trucks and remains on wheels through all of the milling and framing operations, until it is loaded on cars for shipment. Each class of work on the material is done on machines best adapted to the work called for. For example, special framing saws are used for making bevel and compound cuts, such as occur on jack and hip rafters. These saws permit the stock to lie flat on the roller bed of the saw table, against guides and



A Section Foreman's House Recently Constructed With Ready-Cut Lumber

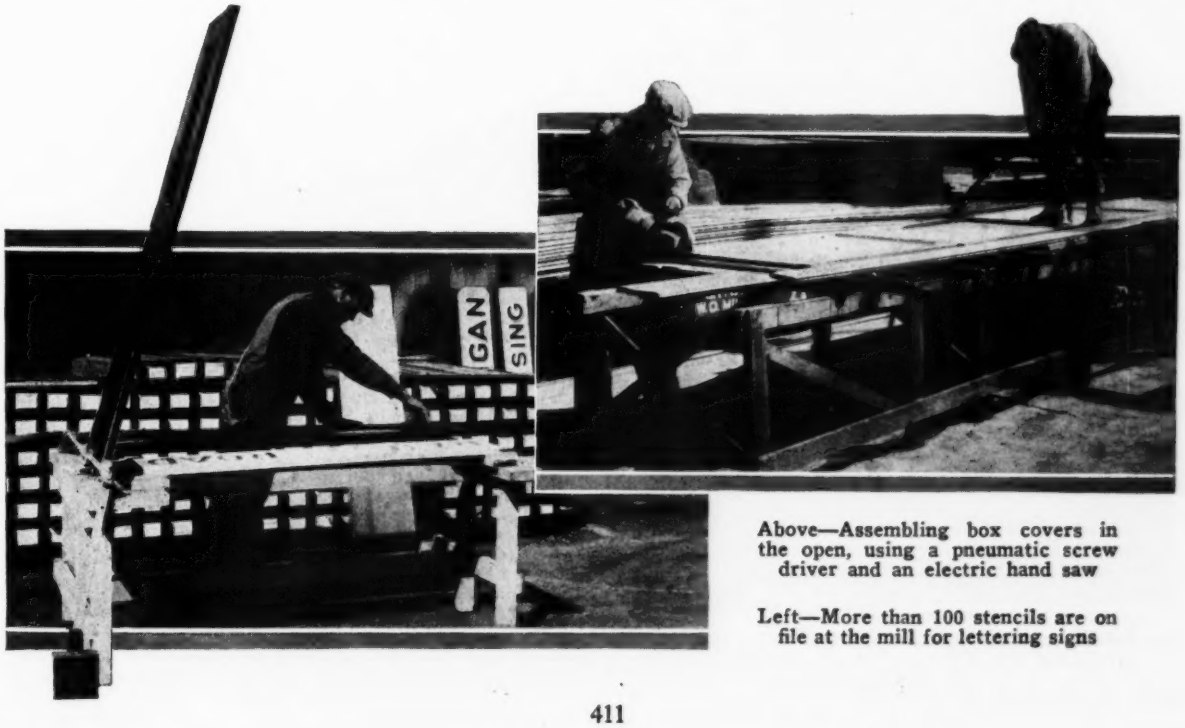
Buildings

stops, while cuts are being made, and eliminate all layout work and marking of the stock after the machine is once set up.

Douglas fir and redwood are the principal woods used in the buildings; redwood being used for all parts in contact with the ground or subject to the weather. Cedar is used for shingles. The members specially prepared at the mill include all joists, studs, rafters, doors, window frames and sash, as well as all bridging and cripples where these items are required in sufficient quantities of the same lengths. Where the quantity of these last named items is small, stock for them is furnished to the job in lineal feet, to be cut by the erection forces. No attempt is made to precut sills, plates, wind bracing, or any of the sheathing or floor boards.

Such items as trusses are usually assembled complete at the mill with all necesary hardware and are shipped in that condition. Doors and sash are also shipped complete ready for installation and, in some instances, doors and inside trim are stained and shellacked at the mill.

In handling a sizable order for building material through the mill, including doors, sash and framed lumber, the sash and door work is released in advance of straight milling and framing work, which is held up until about two days before the date of shipment. In this way, all of the work on a certain order is completed at about the same time, making it possible to consolidate shipments for supply train or way-freight delivery, and, at the same time, avoid tying



Above—Assembling box covers in the open, using a pneumatic screw driver and an electric hand saw

Left—More than 100 stencils are on file at the mill for lettering signs

up lumber trucks with finished material awaiting shipment. Doors, sash, frames and case work, if completed before the requisitioned material as a whole is ready to be shipped, are checked into an assembly warehouse and held for shipment.

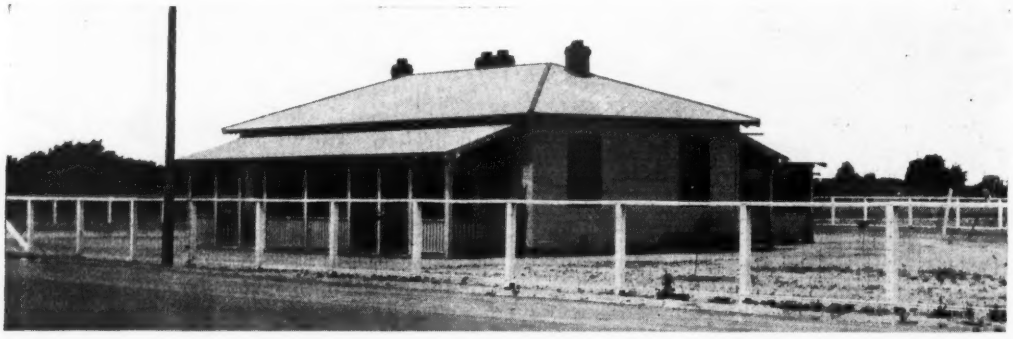
Keep Standard Parts in Stock

In order to expedite the filling of orders and to reduce manufacturing costs by eliminating machine set-ups for small orders, it is the practice to carry on hand a full line of completely machined parts for sash, doors and frames. A number of other items called for frequently in small lots are also manufactured in quantities and held on hand in order to obtain the lower cost incurred in turning them out on a production basis.

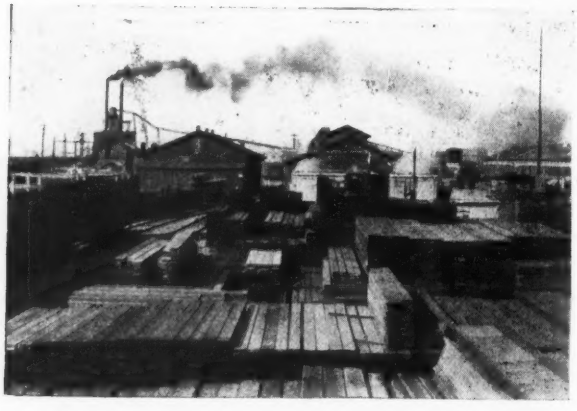
Small buildings are usually shipped complete. In these cases, all materials are assembled, but no shipments are made until all special purchase items have been received. This insures against interruption of the erection of a building on account of a shortage of material. Materials for larger buildings, especially when constructed during the winter months are shipped in the order and at the times they are required. In these instances the proper dates of shipping are fixed by contact or correspondence between the assembly foreman at the mill and the consignee.

In order to simplify erection and, at the same time, to insure against missing pieces or parts which would delay the erection forces, all framed members supplied by the mill are marked with crayon numbers corresponding to the item numbers on the material list, and a careful check of the material is made at the time it is shipped. Shipping from the mill is done by a special crew under the direction of the assembly foreman, who bundles many of the smaller materials for convenience in handling to the job and checks each item against the material list as it is placed in the car. Included with the lumber when shipped is a complete set of standard hardware required for the building, and the copy of the material list reserved for that purpose.

The only requirement to be met by the building forces in erecting buildings from ready-cut lumber is that they prepare the building foundations level and to the exact dimensions called for by the standard plans. If this is done, the framed material supplied maintains the true size and shape of the buildings. In carrying out the field work it is important also that the materials received be sorted and laid out near the site of erection in the sequence of the item numbers so that any piece or pieces of material can be found readily at any time during the work without searching through the entire shipment.



Ready-Cut Lumber Was Used in This Standard Four-Family Laborers' Dwelling



A Section of the Lumber Storage Yard, Showing the Woodworking Mill and Dry Storage Building in the Background

Savings Made in Small Buildings

The advantages of precutting lumber for small standard buildings have been established quite definitely as the result of extended work of this nature which has already been done, particularly during 1929 when the practice of preparing ready-cut lumber on the Southern Pacific was in full effect. Following is a partial list of the buildings for which ready-cut lumber was furnished in that year, which includes the more standardized buildings for which repeat orders are expected:

4 Section foremen's houses
13 Signal maintainers' houses
7 Six-family laborers' dwellings
2 Four-family laborers' dwellings
2 Single-family laborers' dwellings
2 Standard bunk houses
2 Operators' houses
11 Pump houses of different types
26 Sanitary buildings
11 Bath, toilet and laundry buildings
1 Toilet and laundry building
1 Bath and toilet building
13 Section tool houses
1 Car repair and tool room
1 Tool and storage house
1 Caboose supply house
2 Kitchen houses
6 Cook houses
2 Ice houses
2 Combination ice and coal houses.

In addition to the above more or less standard buildings, ready-cut lumber was furnished for a number of special buildings such as storehouses, packing

sheds, freight sheds, etc. Furthermore, the mill turned out about 300 small structures such as toilets, scale houses, section stockmen's houses, watchmen's shanties, etc., which were not only preframed like the larger buildings, but were also completely assembled and painted before shipment.

Advantages of Precutting

Some of the more important advantages of precutting lumber for buildings as demonstrated on the Southern Pacific are: Increased accuracy in the ordering of materials owing to the fact that one list, which has been carefully checked, serves for all of the smaller standard buildings on the system; economy in listing and billing, arising from the fact that after a list has been completed, it is available for all future orders; economy and increased accuracy afforded by machine operations over operations done by hand or by less efficient machines in the field; decreased time of erection forces on the job, who are frequently being boarded at the expense of the company; conservation of trimmings and other waste material, which, at the mill, are salvaged for small products or hogged and carried in a conveyor system to the boilers for fuel; elimination of haul and handling costs on waste; greater assurance that net sizes will be correct and that the kind and grade of stock will be best suited for the purpose for which it is used; and that performance of the lumber-cutting operations is at a location within direct telephone communication with the company architect, which permits of prompt rulings on any questions affecting the interpretation of drawings, the substitution of materials, etc.

A comparison of the cost of preframing with that of framing on the ground seems to indicate a saving of from 10 to 15 per cent in labor charges in favor of the ready-cut buildings, in addition to an undetermined saving in the cost of hauling surplus material and a small saving in the cost of handling. There also appears to be a small saving in materials under the preframing method, but the amount of this saving has not been determined accurately.

While recognizing the advantages of preframing materials for standard buildings, it is not considered practical to preframe the material for buildings of special type and those which are not likely to be duplicated. Much of the lumber for such buildings is received directly from the saw mills and is framed in the field, use being made of power saws whenever convenient. It is hoped ultimately to equip all building gangs with power saws, using electric or gasoline power as may be most suitable.

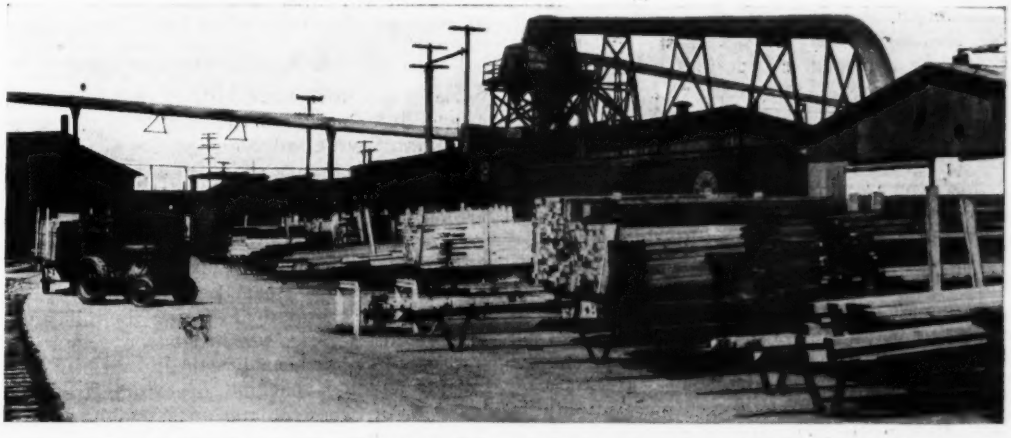
Heavy Timber Framing Bearings, Showing Carpenters Framing Members for a Water Tank Tower

Framing in the field is done principally in points in Oregon, where, if the lumber is purchased locally, a large saving can be effected over shipping the rough lumber to the West Oakland plant and then sending it back to Oregon, several hundred miles, as finished lumber.

Road Is Well Equipped for Work

The maintenance of way wood-working mill at West Oakland, where all of the precutting of lumber for buildings on the Southern Pacific is done at present, is operated by the stores department in conjunction with the extended lumber storage facilities maintained by that department at that point. This mill, which also turns out a wide variety of manufactured products for other than the maintenance of way department, is one of the best equipped railroad facilities of its kind in the country.

The equipment in the mill is unusually complete and includes over 100 important units, designed to perform all of the operations called for. This large layout is the result of adding to the equipment from time to time as new or additional milling operations were taken on, and also as the result of a definite policy of keeping the mill fitted with up-to-date equipment capable of turning out work in the most



Loaded Lumber Trucks of Milled Stock Ready to Be Spotted at Cars for Loading

expeditious manner. A partial list of the equipment in the mill includes rip saws, a matcher, a jointer, a planer, a mortiser, a pointer, borers, grinders, lathes, band saws, a shaper, a circular resawer, a cut-off saw, sanders, miter cutters, a ripper and edger, and a tenoner. Other equipment in the mill includes such facilities as an automatic template for use in drilling the holes for ladder stiles, a window frame machine, a screen stretcher, and numerous items of portable equipment such as electric hand drills, a portable jointer, a power router, paint spray equipment, and automatic staple feeders. All of the various units of woodworking machinery in the mill are carefully spaced to avoid congestion and to facilitate the handling of materials from one machine to another. All of the power units have individual electric-motor drive and separate control.

The output of the mill includes several hundred products in addition to ready-cut lumber for buildings, ranging from such simple items as track shims, surveyor's stakes and packing lumber, to office furniture and completely framed timbers for bridges and trestles. Some of the more common products, other than those mentioned, include box culverts, cattle guards, crossing planks, pole-line cross arms, bridge warning frames, all kinds of right-of-way signs and markers, tunnel wedges, battery boxes, wood and coal boxes, section tool boxes, water barrels, bunks, stock corrals, gates, racks and bins, water tanks up to 50,000 gal. capacity, and frames of various kinds.

Bridge Timbers Framed Before Treatment

All preframing work on heavy timbers, such as those for bridges, trestles and water tank towers, is done immediately east of the woodworking mill, where suitable space and facilities are provided. The material to be used in this class of structures is generally received in carload lots and is unloaded directly alongside a circle saw for resawing to proper dimensions. It is then moved along on a roller bed to a swing saw, where it is cut to length, and then goes to a timber sizer for such final dressing as may be necessary. All of this work is done in the open, except for shelters directly over the machine units. The timbers to be framed and bored are then placed on low timber racks and, in this position, are completely prepared for assembly in the field.

All of this latter work is done carefully in accordance with plans furnished, portable power tools being used exclusively because of the ease with which they are moved about as compared with moving the heavy timbers from one tool or machine to another. In order to insure accuracy of the work before the timbers are sent to the creosoting plant, the different parts of the finished structures, such as trestle bents, for example, are assembled complete, with lateral bracing. In this way, and by stenciling match marks on each piece to indicate its proper place in the structure, accurate assembly is insured in the field without additional cutting of any kind. When the framing of all parts of a structure has been completed, the timbers are loaded directly on cars pushed in on a service track paralleling the framing racks, and are taken to the company creosoting plant nearby. About 95 per cent of all structural timbers prepared at the mill are treated.

All lumber received at the mill is purchased rough green, except flooring and ceiling material and rustic for special trim work, and all stock not moved directly to the mill building on roal-haul cars is carefully piled in the lumber yard for storage and air seasoning. Locomotive cranes are used to unload stock whenever possible, the heavier timbers being handled with timber tongs, while the smaller timbers and boards are lifted from the cars in sling lots and then piled by hand.

As the lumber is unloaded it is regraded and all clear stock and good cutting grades are set aside for use in the manufacture of products requiring the best class of lumber. By following this practice, the Southern Pacific secures about 90 per cent of its requirements for the upper grades of fir and redwood from merchantable grades of lumber, and thereby avoids the necessity of purchasing it at the higher prices charged for select stock.

Much Lumber Is Kiln Dried

All stock for building trim, signs, doors, furniture, boxes, etc., is kiln dried in a large kiln located in the storage yard, directly behind the woodworking mill. This kiln, which is 52 ft. long, has four compartments with a combined average capacity for drying in excess of 100,000 ft. b. m. of stock monthly. All stock for inside trim, and for sash, door and case work, is dried to a moisture content of 6 per cent, while material for exterior use is dried to a moisture content of 10 per cent.

In order to insure proper drying of lumber in the kiln, the heat and humidity in each of the compartments are controlled automatically by Foxboro recording heat and humidity controllers. The recording instruments of these controllers are located outside the kiln and indicate at a glance any failure in the steam pressure to the heating coils, air pressure to the instruments themselves, or leakage in the air-operated control valves of the system.

In addition to the drying process itself, the stock in the kiln is given initial, periodic and final steamings for the purpose of softening the outer fibers to assist the flow of moisture from the center of the stock to the surface, and to relieve strains within the stock. Pronged samples are cut from the stock during the latter part of the drying period to determine the amount of stress between the inner and outer fibers, and excessive stresses are then relieved by special steaming treatment.

A Special Storage Shed

After the stock has been removed from the kilns it is placed in a special storage shed to keep it in the proper condition for use in the highest class of trim and cabinet work. This is particularly important at the West Oakland plant because of the high humidity in that locality, which will not permit air seasoning to a moisture content of less than about 17 per cent. The storage shed is a frame building with an open slat floor, beneath which are low pressure steam heating coils.

The force required to operate the mill and its auxiliary facilities varies somewhat from time to time, but in recent years has been practically uniform at about 110 men, including machine operators, truckers, storage yard men, two detailers, an assembly foreman, a mill foreman and a mill superintendent. In this organization the men have specific work or operations to perform and have become so skilled that maximum output of the mill as a whole is secured.

All work relative to the development of standards for the structures and to the manner of their shipment and erection are handled under the direction of W. H. Kirkbride, engineer maintenance of way and structures, while all of the operations at the mill and lumber yard are carried out under the general direction of A. S. McKelligon, general storekeeper, and H. W. Concannon, district storekeeper, and under the direct supervision of the mill superintendent, C. C. Caldwell.

The Drainage Question

BULLETIN No. 9, which is one of a series issued to the maintenance of way and signal forces of the Buffalo, Rochester & Pittsburgh, discusses questions arising from the problem of track drainage.

Copies of other bulletins, issued by the B. R. & P. from time to time, have been reproduced in previous issues of *Railway Engineering and Maintenance*. This bulletin is devoted to a discussion of the proper removal of water from the roadbed to prevent unstable, centerbound track, the heaving of track and the destruction of ties by decay and mechanical wear. Drain tile and ditches as a means of removing water are emphasized and their proper application is discussed and illustrated by diagrams.

BUFFALO, ROCHESTER AND PITTSBURGH RAILWAY COMPANY

Bulletin No. 9

THE DRAINAGE QUESTION

A matter of the utmost importance to division engineers, roadmasters, general foremen, track foremen and all others interested in or concerned with the proper maintenance of roadbed or track.

WHY IS DRAINAGE NECESSARY?

No structure whether it be a building, highway or railroad roadbed can be properly constructed or maintained so that it will endure without a properly drained foundation. **Thorough drainage is one of the most important principles of track maintenance.** Our problems would be comparatively simple if it were not for the trouble caused by water in, under or near the track and roadbed. Moisture in the soil makes it pliable and unstable under pressure and water accumulating in a railroad roadbed has the same effect and makes it soft and weak under traffic. When such conditions are present, the bearing power of the soil under the tie and ballast is reduced and instead of the load being spread over a wide area, it is confined to a comparatively narrow section of roadbed. Water in, under or near the roadbed destroys the power of the ballast to distribute the load. This causes the track to "pump" and "churn" and the subgrade is sucked up into the ballast, resulting in muddy ballast, low and whipping joints, loose bolts, cut ties, spread track, and bad surface and line.

Do not allow water to stand in or near the track.

In these days of heavy rolling equipment and high speed trains, the track must be in the **best possible** condition at all times to provide for safety and economy in operation. In many cases, the sub-soil drainage problems have increased with the introduction of heavier motive power. Under these heavy loads, the soil is compressed forming depressions under the track that tend to hold water partly on account of the depression itself and also on account of the increased compactness of the soil. Troubles caused by these pockets can be eliminated only by proper methods of sub-soil drainage. **Ditch and lay drain tile.**

WHAT ARE SOME OF THE WORST TROUBLES CAUSED BY BAD DRAINAGE?

Weak unstable track and roadbed which develops unexpected bad spots in surface and line is a direct result of bad drainage.

Center bound track is increased by a high percentage of moisture in the subgrade. This has a tendency to produce rough riding track and under extreme conditions, may result in broken rails.

In cold regions, track maintenance is made much more difficult by the action of frost. This frost action cannot take place without the presence of water. The uneven distribution of water in the soil makes some places heave more than others. This results in uneven surface of the track. When track heaves, the ground is left open and porous as the frost leaves in the spring and this allows water to enter and makes unstable roadbed conditions.

There is only one cause of heaving track and that is water in the ballast or roadbed. **The correction** of this condition is not the use of shims, which is prohibited, but better drainage. **Get the water away from the track. Ditch and lay drain tile.**

Decay of ties and destruction by mechanical wear is hastened and aggravated by bad drainage conditions. The cause of decay is a fungus growth that dissolves certain elements in the structure of the wood. This fungus cannot live and make much progress in causing decay without a certain percentage of moisture. It is most active when the air is warm and when there is the greatest amount of moisture in the wood. Ties that have a high percentage of moisture cannot resist mechanical wear as well as those that are dry. **Keep the roadbed dry. Keep the water moving.**

WHAT ARE THE SIMPLE AND OBVIOUS MEANS OF IMPROVING DRAINAGE CONDITIONS?

The big thing to remember is that water must not be allowed to stand in, under or near the track. It must be removed by ditching and tiling.

Running water should be kept as far away from the track as possible.

Roadbed ditches kept clean and free from vegetation and obstructions at all times will allow the water to run freely and keep it away from the track.

Ample surface ditches properly constructed with good uniform grade, well sloped and lined, and leading to defined water courses will collect the water before it reaches the track and give it a chance to run off.

Creosoted flumes for carrying the water down the slopes to and from the inlets and outlets of pipe culverts will prevent cutting or scouring of the slopes and filling up of roadbed ditches.

Surface ditches constructed at the foot of embankments and parallel with the track will prevent standing water which, if not given a chance to run away freely, will work its way into the embankment causing unstable roadbed conditions.

Borrow pits or holes on the right of way standing full of water are a menace to good track conditions.

WHAT OTHER SIMPLE MEANS ASIDE FROM DITCHING WILL GIVE GOOD RETURNS IN DRAINAGE IMPROVEMENT?

Good deep ballast will aid in distributing the traffic load over a greater area. Sooner or later however much of this material will be driven into the ground and lose its effectiveness for maintaining drainage and proper support for the ties.

It is useless to apply new ballast and not keep the water away from it. It is useless to tamp ties in ballast saturated with water.

Laying drain tile in wet cuts, as called for on standard plans, and tile between tracks where there are evidences of water in the roadbed is essential. After tile has been placed, even though the work was properly done, that is not all of it. The tile must be watched to see that the water is running through it, mud must be kept off the top of the cinder covering of the tile so that the water will have free access to it and when necessary, tile must be taken up, cleaned and re-laid with a good covering of coarse engine cinders.

WHAT SPECIAL PROBLEMS REQUIRE PARTICULAR STUDY AND EFFORT TO IMPROVE DRAINAGE?

Drainage at highway and farm crossings presents a situation requiring special study and effort. Creosoted drain boxes should be placed at road crossings and at frequent intervals on double track especially on grades for conveying the water from between tracks. Ditches of proper size and slope at the sides of crossings and paved with field stone to prevent scouring and washing will collect water which accumulates on or near the highway or road and carry it **away** from the track. The construction of diversion ditches wherever possible some distance from the track especially where the road slopes toward the track will catch the water and prevent it from running down on the crossing.

Drain tile laid on each side of the track and between tracks through crossings collects water which might otherwise reach the roadbed and carries it away before it can damage the track.

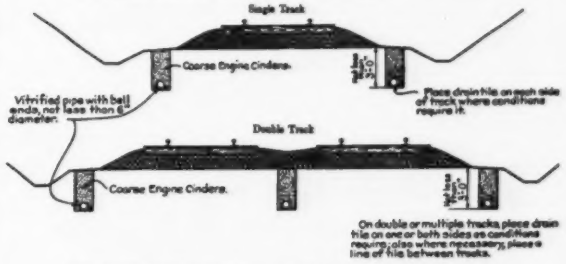
Each crossing is a study in itself and requires special treatment. Use every means possible to keep water away from the track at crossings.

Another special problem is the condition at and near switches where drain boxes and tile must be resorted to wherever necessary to keep the water out of the track.

A very common problem of track maintenances is the existence of so-called sink holes under or near the track. These are nothing more than water pockets caused by springs, depressions or fissures in the subgrade or they may be caused by deposits of clay in fills made when the road was built. These places must be drained with tile or by digging down on the outside of the fills and providing openings for the water to run out, backfilling with coarse material such as stone or cinders. Standing water in, under or near the track is our worst enemy and must be removed. Drainage must be kept uppermost in our minds throughout the year in all work. **Do not allow drainage to become clogged. Keep the water moving.**

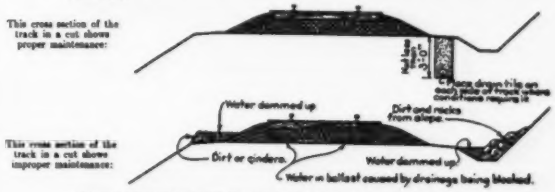
WHAT IS THE RIGHT WAY TO LAY DRAIN TILE TO GET THE BEST AND MOST LASTING RESULTS?

Our standard plan calls for placing drain tile not less than 3 feet below the subgrade. Drain tile must be laid deep enough to prevent the water from being "sucked up" through and into the ballast by the movement of traffic. Even where the ballast is supported on a rock subgrade, it is necessary to place drain tile deep enough in the rock to take all of the water away from the pockets or fissures in the rock. As a **general rule, drain tile must be placed as deep in rock cuts as in other places.** Drain tile must have enough fall to keep the water running freely and where the track is not on a grade which can be followed for the slope of the tile, engineers' stakes must be set. Drain tile should be laid and backfilled with coarse engine cinders in accordance with standards as shown below:—


Single Track
Coarse Engine Cinders.
Vitrified pipe with bell ends, not less than 6" diameter.
Place drain tile on each side of track where conditions require it.
Double Track
Coarse Engine Cinders.
On double or multiple tracks place drain tile on one or both sides as conditions require; also where necessary, place a line of tile between tracks.

WHAT CONSTITUTES PROPERLY DRAINED AND MAINTAINED TRACK AND ROADBED?

Good track conditions require a stable well-drained roadbed, with good depth of clean, well-drained ballast for the support of the ties and track structure. Roadbed ditches must be well formed with uniform grade and slopes and kept clean and free from dirt, vegetation or rocks which would dam up the water. The subgrade shoulder should be sloped away from the track and should be kept clean and free from vegetation or dirt.


This cross section of the track in a cut shows proper maintenance:
Place drain tile on each side of track where conditions require it.
This cross section of the track in a cut shows improper maintenance:
Water dammed up
Dirt and rocks from slope.
Dirt or cinders.
Water dammed up
Water in ballast caused by drainage being blocked.

AT WHAT PARTICULAR SEASONS SHOULD DRAINAGE BE GIVEN ATTENTION?

Drainage is an ever present problem.

In the winter, existing ditches must be opened and cleaned, new ditches dug, waterways opened, drain tile placed and additional creosoted drain boxes and flumes must be placed wherever they will improve the conditions. **Keep the water running.**

In the spring, ditches must be opened and cleaned, new ditches must be made, inlets and outlets of all culverts, pipes and drain boxes must be opened and drain tile, creosoted drain boxes and flumes placed as necessary. **The water must be kept running so that the track will dry out as soon as possible.**

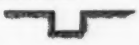
In the summer, during the progress of the season's work, such as rail renewals, tie renewals, surfacing and ballasting, the matter of drainage must be kept foremost in mind. The track must be kept filled in and dressed off. Crossings must be stripped out to get rid of muddy ballast as far as possible to do so. Drain boxes must be placed at all points where water is likely to accumulate especially at farm and highway crossings, switches, crossovers, etc. Additional tile and creosoted flumes and drain boxes must be placed as required to improve drainage.

In the fall, all ditches and drainage features must be put in good shape so as to get the water away from the track and let it go into the winter with the roadbed as dry as possible, thus avoiding heaving. **Do not allow water to stand in or near the track.**

IS THERE A RIGHT WAY AND A WRONG WAY TO MAKE DITCHES?

Whatever is worth doing is worth doing well and this applies with particular force to the work of ditching. Ditches must be made of ample width and properly sloped, like this:—

Do not make ditches with straight sides, like this:—



Do not make crooked ditches, like this:—

But make them straight, like this —

The importance of drainage must be kept constantly in mind. Clean ditches, dry cuts, plenty of drain tile, drain boxes and flumes properly placed and maintained, all make for better drainage.

Read again Bulletin No. 4, drainage.

E. W. HAMMOND,
Engineer Maintenance of Way.

Approved:
E. F. ROBINSON,
Chief Engineer.

Rochester, N. Y.
January 6th, 1930.

Operating Motor Cars Safely

By C. R. KNOWLES‡

*Part I—What accident statistics show—The hazards of speed—How to avoid collisions**†*

THE TRACK motor car is generally recognized today as essential to the efficient maintenance of the railways. Like the automobile, the motor car is here to stay because it has demonstrated its utility. Also, like the automobile, accidents have occurred in its operation.

The accident record is the greatest single objection to the motor car. Yet, in spite of the accident record, the use of motor cars is constantly increasing, and there is no more likelihood of the railroads discarding them for the hand and push car than there is of the American public discarding the automobile for the horse and buggy.

Such accidents as have occurred have not been due to inherent defects in the cars, as the railways have provided safe cars, equipped with proper safety devices and have put forth every effort to maintain them in safe condition. The element of danger in motor cars arises almost entirely from the manner in which they are operated. They are no more hazardous than any other tool when operated in a safe and orderly manner, and if motor-car accidents are to be avoided this must be accomplished through the efforts of those responsible for their operation.

Qualifications of an Operator

Those in direct charge of the operation of motor cars should have the requisite qualifications, including a thorough knowledge of the cars and their proper operation; they should have good sight and hearing and should be familiar with the rules. Above all, they should have a full sense of their responsibility for the safety of the car and its occupants.

It is difficult, if not impossible, to estimate the aggregate loss due to motor-car accidents. They cause a heavy expense to the railroads through interruption to work, loss of time and damage to property, but more than this they inflict both mental and physical suffering on the injured and their families, to say nothing of the effect upon their struggle for existence. Therefore, the aggregate loss is something that goes beyond the mere value of money and cannot be expressed in dollars and cents.

Motor Car Accidents Now Segregated

The Interstate Commerce Commission has placed non-train casualties in connection with the operation of motor cars in a separate classification since January, 1923. During these years the accident reports indicate that one out of every eight deaths in non-train railway accidents has been due to motor-car operation. This record is the basis for the charge that motor-car operation is dangerous.

Statistics on Motor-Car Accidents

Year	Motor and Hand Cars Struck by Cars or Locomotives		Motor-Car Non-train Accidents		Hand-Car Non-train Accidents		Total Motor and Hand Car All Accidents	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
1923	52	177	50	3,113	8	1,345	110	4,635
1924	34	90	62	3,341	7	1,069	103	4,500
1925	47	161	53	3,226	8	1,067	108	4,454
1926	31	121	58	3,478	5	993	94	4,592
1927	45	116	68	3,026	3	783	116	3,925
1928	27	78	53	2,450	2	559	82	3,087
1929	35	62	37	2,022	4	519	76	2,603
	271	805	381	20,656	37	6,335	689	27,796

During the seven years from 1923 to 1929, inclusive, Interstate Commerce Commission accident reports show that 689 persons were killed and 27,796 injured in hand and motor-car accidents. A tabulation of these accidents by years appears on this page.

No figures are available as to the number of hand cars in use, but it may be estimated to be 6,000, and with the 60,000 motor cars estimated to be in operation, one arrives at a combined total of 66,000. On this basis there was a reportable injury for each 21 hand or motor cars operated in 1929.

Nearly 9 per cent of the deaths, and more than 22 per cent of the injuries in non-train accidents in the seven years referred to were due to the operation of hand cars. Assuming that 10 per cent of the cars in operation during this period were hand cars, they show a slightly lower ratio of deaths in non-train accidents, while their ratio of injuries in non-train

* This is the ninth of a series of 15 or more articles on the Care and Operation of Motor Cars, the first of which, on the Place of the Motor Car in Railway Work, appeared in the January issue, page 5, the second on the type of Motor Car, in the February issue, page 54, the third, on the Motor Car Engine, in the April issue, page 158, the fourth, on How a Motor Car Is Built, in the May issue, page 214, the fifth, on Proper Lubrication, in the June issue, page 248, the sixth, on Ignition in the July issue, page 295, the seventh, on the Care of Motor Cars, in the August issue page 339, and the eighth, on How to Secure Efficient Operation from a Motor Car, in the September issue, page 376.

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‡ Mr. Knowles is in charge of the operation and maintenance of motor cars and other gasoline-operated work equipment on the Illinois Central System.

The Responsibility Is Invariably Placed Upon the Motor-Car Operator

accidents is more than double that of motor cars.

Casualties resulting from hand and motor cars being struck by cars or locomotives are not separated; therefore, a comparison of train accidents is not possible, although in all probability motor cars will show a slightly higher ratio than hand cars in both killed and injured.

Causes of 475 Motor-Car Accidents

Nature of Accident	Number
Collisions with locomotives or cars	136
Collisions with automobiles	68
Collisions between motor cars	22
Derailments due to objects on track	27
Derailments due to unknown causes	26
Derailments on frogs, switches and derails	17
Starting and pushing cars	40
Placing cars on and off track	38
Falling from car	20
Getting on car while in motion	16
Tools or other objects falling from car	14
Striking animals	12
Getting off car while in motion	8
Men caught between motor car and trailer	6
Feet striking rail, cattle guard or crossing	6
Trailer becoming uncoupled	5
Striking persons	3
Car catching fire	3
Persons or car striking stationary object	2
Pushing trailer car	2
Scalded by water from cooling jacket	2
Failure of wheel	1
Broken axle	1
Total	475

In Circular 242 of the Safety Section, American Railway Association, it is stated that 95 per cent of all accidents resulting from the operation of hand and motor cars are preventable. This statement is supported by an analysis of the causes of 475 motor-car accidents on a middle western railroad over a five-year period, which appears on this page.

This tabulation includes all accidents and does not differentiate between those in which injuries occurred and those in which no one was hurt. For this reason the record does not show the same ratio between train and non-train accidents as the Interstate Commerce Commission reports, as the latter take into consideration only those accidents involving deaths or reportable injuries.

A check of the causes of accidents given above will show that they are typical of nearly all motor-car accidents and that 95 per cent are preventable. Manufacturers of motor cars have directed their efforts toward perfecting the safety of the cars, and the railroads have worked toward the same end.

Investigations of motor-car accidents invariably develop that they are due either to failure to observe the rules or to careless practice. The mere drafting of rules is not enough. The safe operation of motor cars and the prevention of accidents demand that they be observed by the men and enforced by the officers, and that infractions of the rules be punished by the application of proper discipline.

Speed

It is generally agreed that excessive speed is responsible for more serious motor-car accidents than any other one condition, and that it is a factor contributing either directly or indirectly to the majority of accidents. As a result, efforts directed toward the prevention of motor-car accidents invariably stress the importance of controlling the speed of cars.

The principal advantage in the use of motor cars is that they save time, and their operation should not

be hampered by unreasonable speed restrictions. If the maximum efficiency is to be derived from their use they should be operated at the highest rate of speed consistent with safety when conditions require it. The elimination of accidents due to speed is simply a matter of establishing what a safe speed may be under different conditions of operation, and then insuring proper control.

It is a common error to construe the term excessive speed as applying only to a speed in excess of the maximum established by the rules governing motor-car operation. Many accidents are due directly to a speed which may be well within that permitted by the rules, as for example at road crossings, over

All That Was Left of One Car After a Collision

frogs, switches, derails and by points where cars, buildings or other obstructions offer a limited range of vision.

There is no one speed at which it is safe to operate a motor car under all conditions; what is safe in one case is unsafe in another, and what may be unsafe under certain conditions may be both safe and desirable under other conditions.

A good general rule, providing it does not conflict with the limiting speed, is that the car shall be under such control at all times that it can be brought to a stop within one-half the range of vision.

Motor cars must have a certain amount of reserve power for use on grades, sharp curves, against head winds and for pulling trailers. This power can, of course, be converted into speed with a light car, on level track, on a descending grade or under other favorable conditions. Therefore, the speed of the car must be controlled by the operator, and it is only through him that safe speeds can be maintained.

It is frequently suggested that cars be equipped with governors so that the maximum allowable speed cannot be exceeded. This has been tried, but has not proved satisfactory. Even if a satisfactory governor could be devised, it would probably require more effort and discipline to control its use than to control the speed of the car without a governor.

There is little uniformity on different railroads as to the permissible speed of motor cars, and few officers appear to have recognized the necessity for regulating the speed of cars according to their type and class of service. It is a rule on many roads that motor cars shall not exceed a speed of 15 miles per hour, while others have fixed the limit at 20 miles per hour. These rules are being violated constantly, as their strict observance would detract from the value of certain cars for certain service, as for example, party inspection cars.

These open violations of the restrictions as to speed, largely by supervisory and other officers, lead to laxity in the observance of all rules, as it is hardly expected that the rank and file will show respect for rules that are not observed by their superior officers. Therefore, it would appear desirable to establish varying speeds for different types of motor cars.

The following are suggested as maximum speeds for various types of cars and service conditions:

Party inspection cars	25 m.p.h.
Gang cars in good condition without tools	25 m.p.h.
Gang cars in ordinary work	20 m.p.h.
Light center-load inspection cars	20 m.p.h.
Gang cars with trailers	15 m.p.h.
Side load cars	15 m.p.h.
All cars through station grounds	8 m.p.h.
All cars over frogs and switches	8 m.p.h.
All cars through interlocking plants	8 m.p.h.
All cars over highway crossings at grade	6 m.p.h.

The speeds designated are for normal conditions and are based upon the assumption that track and other conditions are safe for such speeds. Modification may be necessary on some roads, and conditions under which the cars are to be operated must, of course, be given proper consideration. It may be desirable to operate certain types of heavy-duty inspection cars at a higher rate of speed than the maximum given in above table. If so, this should be clearly set forth in the rules.

Collisions

Collisions with locomotives or cars, automobiles and other motor cars are responsible for nearly half of all motor-car accidents. Collisions with trains alone comprise 30 per cent of the total. Fortunately, the casualties from collisions with trains are not in direct proportion to the number of accidents, although the number killed leads those from all other causes. The property damage is also greater than from any other one cause, for the motor car is completely destroyed in many cases, and the locomotive or train is sometimes derailed with resultant damage.

Particular stress should be placed upon the importance of protecting cars against trains, as these accidents can be attributed only to carelessness in the operation of the motor car. Line-ups of train movements are important and should be secured whenever they are necessary for safe operation, and particularly when long trips are made or where the car is operated beyond the limits of its assigned territory. It should be thoroughly understood, however, that a line-up does not relieve the operator of the car of the responsibility for its safe operation.

The issuance of a line-up for every movement of a motor car would place a heavy additional burden on the dispatcher and would lessen the efficiency of motor cars by restricting their movements. On the basis of an average of four movements daily for each of the 60,000 motor cars in service, it would involve a total of 240,000 line-ups each day. This would entail considerable work, while the movements of the cars would undoubtedly be hampered somewhat both by reason of delay in securing the line-up, as well as the restrictions placed upon the car through its observance.

Where motor cars are operated on long stretches of straight track or where other conditions are such that it is safe to operate cars without line-ups they may be dispensed with. As a rule, however, the operator

of the car should either have a line-up from the dispatcher or other authentic information as to the movement of trains. Telephone communication has become so well established on railroads that there should be little difficulty in keeping in touch with the location and movements of trains.

The line-up is furnished simply as information and is not infallible. This is particularly true on railroads with two or more main tracks as trains may be detoured and operated against traffic after a line-up for regular traffic has been given. Section or other forces are sometimes located at points where they cannot readily obtain a line-up; in other cases the time covered by the line-up may have expired. Under such conditions extreme caution should be observed and if there is not a clear view the car should be protected by flag.

Collisions with trains rarely occur on straight track or where a clear view is possible. They take place on curves or at other points where the vision is not clear. Protection by flag should be provided in all cases where the positions of trains are unknown and the view is not clear for a sufficient distance in both directions to permit of removing the car from the track or otherwise clearing a train. This is particularly true on curves, long bridges or tunnels. Set-offs should be provided on long high fills, in cuts, and on bridges, or where conditions are such that the car cannot readily be placed on the ground within a distance of one-fourth mile.

In order that a car may be removed from the track quickly if necessity should arise, each man should be assigned a definite place on the car and there should be a thorough understanding as to the part that each man will take in removing the car from the track and as to the side of the track on which it will be placed. If this practice is followed it will insure prompt and concerted action if it should become necessary to remove the car in the face of an approaching train. The same order should be followed in removing the car from the track in all cases, whether an emergency exists or not, so that the men may become familiar with what is expected of them.

Cars should not be operated in fogs or at night except in extreme emergency. If it becomes necessary to operate a car during a fog it should not be run at a speed greater than 8 miles per hour, and frequent stops should be made to listen for approaching trains. White lights should be displayed at the front and red lights at the rear of a car when it is operated at night or through tunnels.

On lines with more than one main track, a motor car should move with the current of traffic, and where there are separate tracks for passenger and freight trains a motor car should be operated on freight tracks. When the car is occupied by two or more men, at least one man should always face the rear with instructions to look out for following trains.

Safety at Highway Crossings

The increased number of automobiles has added materially to the hazard of motor-car operation. Among motor-car accidents, collisions with automobiles and other vehicles at highway grade crossings rank second only to collisions with locomotives, and cars. Regardless of how careless the driver of the highway vhcicle may be, the responsibility for the accident is invariably placed upon the motor-car operator. The only safe course, therefore, is to give the highway vehicle the right of way. These accidents not only endanger the railroad employees who may be upon the motor car, but also cause further complications because of the possibility of injury to the occupants of the highway vehicle, followed by damage suits.

A motor car should be under complete control when approaching highway or street crossings and should be brought to a stop unless an unobstructed view can be had along the highway for at least 200 ft. in either direction.

Collisions between motor cars are not at all unusual and have resulted in some very serious accidents and heavy loss of life. They rank seventh in frequency of motor-car accident, but in number of killed and injured per accident they probably head the list, as most of them occur with little if any warning, and the occupants rarely have a chance to seek doubtful safety by leaping from the car. Many of these collisions occur at night and are caused very largely through the failure of one or both cars to display proper lights.

So much has been said regarding the importance of displaying lights when operating motor cars at night or in fogs that there is nothing that can be added here as an argument for their use in preventing collisions between motor cars. Other causes of collisions between motor cars are improper spacing of cars while running, lack of proper understanding between the operators of cars, failure to keep a proper lookout, and high speed.

One Man Should Always Face the Rear

Every motor-car operator should be properly impressed with the fact that he may meet another motor car at any time and that the same precautions should be observed in protecting against it as against trains.

Established rules should govern the spacing of motor, hand and push cars or trains. Unless properly coupled, they should not follow within 500 ft. of other cars or trains, and there should be a distinct understanding between the operators of the cars as to the movements of both cars. Accidents resulting from one motor car colliding with another can only be due to gross carelessness on the part of the operators of one or both of the cars. They can be avoided by competent motor car operators. [Part II and Part III of this discussion of motor-car accidents will follow in succeeding issues.]

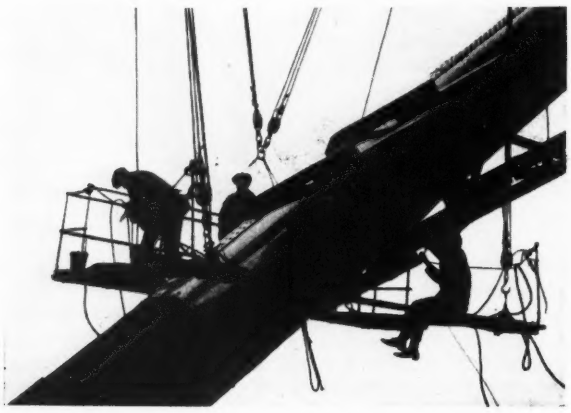
One of the World's Largest Bridges

UNTIL the completion of the Quebec bridge in 1917, the Firth of Forth bridge in Scotland contained the longest clear span of any railway bridge in the world. However, as the Forth bridge contains two spans of 1,700 ft. (center to center of bearings) and the Quebec structure a single span of 1,800 ft., the former is still a record structure of the cantilever type. It was completed on March 4, 1890, after a construction

The Great Forth Bridge

period of seven years, during which 57 workmen lost their lives. The bridge comprises an important element in the east coast route of the London & North Eastern near Edinburgh.

The structure is 7,870 ft. 8 in. long, of which the cantilever portion occupies 5,349 ft. 6 in. It provides a clear headway for navigation of 150 ft. and the top of the highest member is 360 ft. above water. The steel used in its construction totaled 54,160 long tons (60,659 short tons). The bottom chords and compression diagonals of the cantilever arms and the tower columns are of tubular construction, and the latter, which are the largest, are 12 ft. in diameter. The floor construction is unlike that employed on American bridges. The rails of the double-track line are of the inverted flanged U-type, weighing 121 lb. per yd. and are supported by open-top box stringers, which enclose teakwood rail bearers on which the rails rest. The space between stringers is enclosed by buckle plates, thus making a solid floor. A sidewalk flanks each outside stringer.



Painting One of the Tubular Members

This enormous bridge, with a steel surface area of 135 acres and spanning as it does a tidewater river, presents an extraordinary problem of maintenance. Every square foot of surface is painted at intervals of three years under a continuous painting program. This involves the application of 18 tons of paint per year and the employment of 55 painters in the summer and 45 in the winter.

I. C. Finds Paint Spraying Economical

ALTHOUGH the first patent covering paint-spraying machines was issued nearly 60 years ago, it is only in recent years that this form of equipment has been adapted to railway uses. While progress has been slow there is no doubt that machine painting is destined to supplant brush painting, except for striping and trimming and even these may be taken care of by future developments.

There are 19 paint-spraying outfits on the Illinois Central, all of which have been placed in service within the last three years. The results obtained from the use of these machines have demonstrated their value, this being particularly true on the New Orleans Terminal division where the painting program included practically every building. The structures painted include section foremen's and section laborers' houses, tool houses, camp cars, freight houses, car inspectors' tool houses, transfer and train sheds, carpenter shops, yard offices, tanks, viaducts, warehouses and interlocking towers. Careful records on this work demonstrate that the cost of labor for machine painting, including all structures, was about one-half that of brush painting. The labor required for flat work, such as painting buildings within 12 ft. of the ground, showed a much greater reduction, in some cases a machine requiring only 25 per cent of the labor required to do the same work by hand. For example, a test section showed that three squares could be painted by the spray machine in seven minutes while the same area required one hour to cover by hand. The amount of paint consumed in flat work is about the same with the machine as when applied by hand, except that when a strong wind is blowing the consumption by the machine is slightly greater.

The amount of labor required is also influenced somewhat by the amount of trim, as where two colors of paint are applied, brush painting then being necessary. The spraying machine is able to paint within about three inches of the border of the trim. Any painting within 12 ft. of the ground can be done with an extension nozzle without scaffolding. It is found that where scaffolding is used, the paint spraying machine will reduce the cost about 20 per cent, as a much greater area can be covered from a given point. One gun will use about 25 gal. of paint in eight hours on a flat surface. Two paint barrels or tanks are usually furnished with each machine to permit of using two different colors. The paint is mixed to about the same consistency as when applied by hand and no more labor is required to prepare the paint for spraying than for brush work, although it is necessary to clean the guns at night, which requires 15 or 20 min.

There is a certain amount of waste in painting structural steel, particularly light foot bridges and viaducts, but with the proper adjustment of the spray gun, the waste can be greatly reduced. The work is also somewhat slower and more labor is required than when painting flat surfaces. However, the spraying machine does a much better job and the

paint can be applied to points that are never reached by the brush.

A 100,000-gal. wood water tank was recently painted with one of the spraying machines, using 39 gal. of paint as compared with 44 gal. necessary to do the work by hand. A saving of $25 in labor was also effected on this structure. No complaints have been made by the operators of the machines in regard to the paint fumes, although respirators are utilized when interior work is done.

A New Device for Cleaning Windows

THE large window surfaces which are becoming standard in railway shop construction present a somewhat troublesome problem with respect to cleaning, particularly on the outside of the building. For obvious reasons it is not feasible to erect a permanent staging to give access to such surfaces. On the other hand, a portable frame of sufficient size to reach the full height of the windows and at the same time permit all parts of the surface to be reached is seldom practicable because of its weight, while such a device often cannot be used because of tracks along the side of the building.

Trolley and Suspended Cage for Cleaning Shop Windows, C. R. I. & P.

To overcome these handicaps, the Chicago, Rock Island & Pacific has devised a movable cage which is suspended from a specially designed trolley-type track that is carried by cantilever arms attached to the brick wall above the top of the window frames. The cage is constructed of light structural sections, is open on the side next to the building and is wide enough to accommodate two men and their window-cleaning equipment. The floor of the cage is of the open-gate type with closely spaced bars to prevent supplies or equipment falling through. Outside shelves are placed at a convenient height at each end of the cage to accommodate water buckets.

The cage can be quickly and easily raised or lowered by means of a differential-gear chain block attached to the end of the shaft which carries the suspension chains. The wheels which run on the lower flange of the trolley rail are equipped with ball bearings, so that they also allow the movement in the horizontal direction to be made with ease.

The cage can be constructed of second-hand structural material which is unfit for further use in bridges or other structures where it will be put under heavy stress. In general, new material will be required for the trolley and the incidental equipment. The cost for the installation is comparatively small, however, and the Rock Island has found that the facility with which the windows can be kept clean and the reduced cost of doing the work warrant installations of this type where large window areas must be cleaned.

We are indebted to A. T. Hawk, architect, for the photograph and the information upon which this article is based.

What Does It Cost to Renew a Wire Rope?

By W. H. SLINGLUFF
American Cable Company, Inc., New York

INTERRUPTION in steam-shovel operation is a serious matter, whatever the cause. That is why it is economy to complete a cable restringing job as quickly as possible. Two men are ordinarily required to restring a shovel. For a small shovel, say of one-yard capacity, they can make a replacement of the hoisting rope in an hour.

To assume that a rope replacement costs only the price of a new rope, plus the wages of the men who do the stringing, is to fall far short of the real cost. This would perhaps be the whole cost if the job were done at night or on Sunday, but all too often a rope comes to its end during working time. Then the most accurate as well as the simplest measure of rope replacement cost is the value of the production lost during the shutdown, plus the cost of the new rope. This production value includes the wages of the idle crew, and interest and depreciation on the idle equipment.

In any case, but especially when replacement involves a shutdown, the handling qualities of the rope have a bearing on the time, and thereby on the cost of restringing. When the rope used is free from "crankiness," tends to lie straight rather than to go into kinks, and may be cut without siezing, the job is speeded up and its cost reduced.

What of Worn Sheaves?

One of the chief items of maintenance is sheave replacement, refacing or regrooving as the case may be. As grooves wear they take the size and form of the cable working in them. Consequently a rope worn to undersize, as a rope at the point of replacement naturally is worn, means undersize grooves; and if there is any form of abuse which wire rope will not stand, it is to be pinched in an undersize groove. So disastrous is this action that it should be an unvarying practice to make such inspection, replacement or repair as will insure grooves of proper clearance for each new rope.

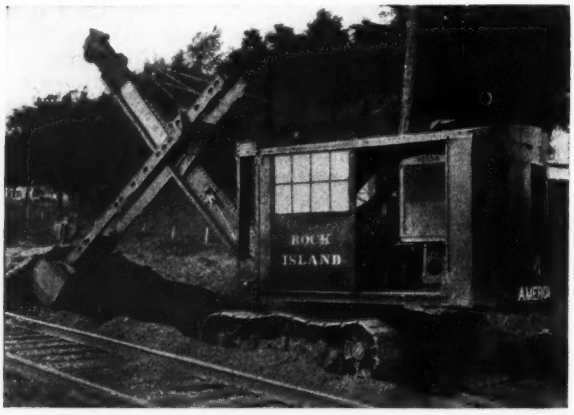
Only in case a rope fails prematurely, while it is practically unworn and before the grooves have had time to wear appreciably, is it likely that rope replacement can properly be made without attention to the sheaves. Another exception might be made for

those sheaves having groove surfaces of manganese steel whose resistance to abrasion renders it almost immune to wear. It should be said in passing that this hard sheave material is of immense value in getting longer life from wire rope. The better the rope and the greater the inherent life built into it, the more important becomes the factor of sheave material.

In general, therefore, the question of sheave replacement or repair arises at the same time as rope replacement, and as frequently. For that reason the cost of sheave maintenance should be added to the price of the rope in arriving at the total cost of rope replacement. The three together give the aggregate cost of the replacement and the total of these costs divided by the life of the rope gives the cost per hour, per ton or per yard of material handled. This is the item which must be considered when deciding what grade and construction of rope and what sheave material should be used.

All Costs Must Be Considered

When the total rope and sheave cost is arrived at in this way, the overwhelming experience of shovel operators is a vindication of the old adage, "The best is cheapest." It account for the rapid adoption of high-



Rope Replacement Is an Element in the Cost of Operating a Machine Like This One

grade rope of the best grades of steel, manganese steel for groove surfaces and cast steel for drums. That the shift to these materials is not a stampede can be explained only by the failure of those in charge to take into account all of the costs of rope changes on a per-yard basis.

Further consideration of the cost factors involved in rope replacement show interrupted production to be a substantial element. It may not be the largest item, but it is well worth while reducing or eliminating if possible. The obvious way to eliminate lost production is to make changes during nights or on Sundays. To do this economically necessitates running the rope as close as possible to the end of its life before replacement. This in turn demands consistency in rope performance, and a behavior that will indicate the approach of failure so that it may be removed before failure occurs.

Both because of erratic performance among ropes themselves, and more especially because of variations in operating conditions, it is customary—and fairly so—to judge the merits of a brand or a construction of rope by the average performance of several samples. Hundreds of careful observations have shown that, besides differences in average life, there are differences in consistency. Here, too, the advantage is with the higher grades and most advanced construction.

Uniformity in Quality an Advantage

Advantage may be taken of this greater consistency when it is the policy to run a rope close to the end of its life and then change it during idle time. If time or yardage be taken as the basis for the change, the point of minimum life, or a point close to it, must be selected as the change point. That rope which has a minimum closest to its average life will permit using the highest percentage of its life without risking failure during working hours.

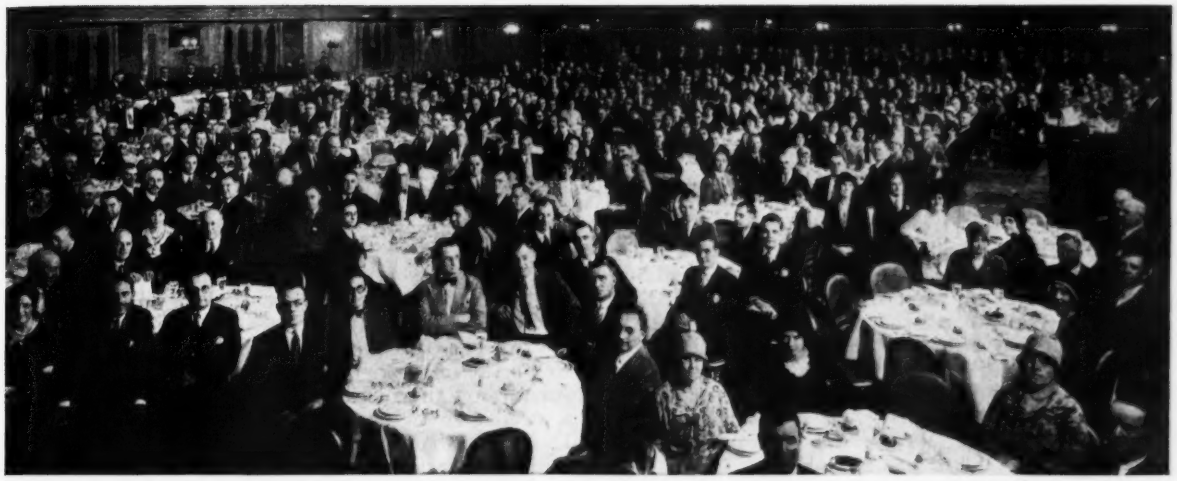
On the other hand, if, as usually seems more practical where the severity of working conditions fluctuates, inspection rather than attained life be used as the basis for deciding on the replacement point, there is an advantage in using cable which fails first on the outside—that is, by the normal wear of the exposed surface wires which eventually weakens them to the breaking point. This means simply that the internal friction or chafing among the strands of a cable should be reduced to a point so low as to be very small in comparison with the external wear. Lubrication, to the extent that it can be made effective, mitigates internal friction. But even when the supply of lubricant is maintained, it is effective only up to the point where pressure betwen opposing surfaces squeezes out the oil and permits metal-to-metal contact.

Once metal-to-metal contact occurs—and there is plenty of it under the most favorable conditions of wire rope operation—a law of elementary mechanics tells us that the amount of friction is in direct proportion to the coefficient of friction and also to the pressure betwen the surfaces. The coefficient, of course, depends on the material, smoothness and lubrication of the contacting metals. It comes into play as it is multiplied by the other factor, pressure. Even this product of coefficient times pressure sets up friction and wear only when there is sliding movement between the surfaces, and in a wire rope this occurs only when the rope changes shape; that is, as it bends on the sheave or drum and straightens out again. That is why a rope, when pinched and distorted as it enters the groove, has its life quickly ground away.

Normally, however, pressure among strands and wires at the moment of bending or straightening is due chiefly to spring tension in the wires themselves. The higher the grade of steel used, the higher is the elastic limit, and consequently the greater is the amount of spring tension which it can retain in the finished rope.

Whether it be on a large dipper or a little dipper, the route to economy in the use of wire rope is much the same, namely:

1. Use rope of such quality and construction that the combined costs of rope, installation, sheave maintenance and lost production will be the least for each yard of material handled.
2. So far as possible, anticipate rope failure and make replacements during idle time.
3. When replacing on a time or yardage basis, select wire rope showing the greatest consistency in performance.
4. When replacing on an inspection basis, use rope having internal wear negligible in comparison with external wear.



The Annual Dinner Was Attended by 533 Members and Guests of the Roadmasters' and Track Supply Associations

Roadmasters Discuss Current Problems

Convention held at Hotel Stevens, Chicago, evinces sustained interest of the members

THAT THE attendance of more than 250 railway men at the forty-eighth annual convention of the Roadmasters' and Maintenance of Way Association at the Hotel Stevens, Chicago, on September 16-18, was only slightly below the record established last year, is an indication of the interest that track men take in this organization. The fact that the exhibit of the Track Supply Association, which has for 19 years been presented coincident with the convention, was larger than ever before, measured both in the number of firms participating and in the space occupied by exhibits, was further evidence of the stable character of this convention.

The convention, therefore, offered further evidence of the high regard with which the association is held by maintenance of way officers as well as by their executive superior officers, and the confidence displayed by those who attended was amply rewarded, for the committee reports and paper presented were of a high order and were actively discussed.

Interested in Committee Work

Another measure of the enthusiasm of the membership is indicated in a statement of President Earl E. Crowley, roadmaster, Delaware & Hudson, Oneonta, N. Y., in his address during the opening session. "In past years," he said, "when appointing chairmen and members for committee reports, it has been difficult for the executive committee to choose members for this work. This year, the executive committee decided to send out a questionnaire to all members registered at the last convention, listing the subjects to be studied and asking those who cared to volunteer for committee work to indicate their preference. The response was so gratifying that there was little difficulty in choosing our committees."

The subjects chosen for study and report by committees were definitely related to problems now confronting the officer of track maintenance and also designed to promote consideration of future trends. Three of the reports had to do with problems of organization, namely those of the committees on The Equation of Track Mileage as a Basis for the Distribution of Forces; Getting the Most from Labor-Saving Equipment; and the Division of Work Between Section and Extra Gangs. In the presentation of these reports or in their discussion references were made to the new form of track organization being developed on the Great Northern and the Chicago, Milwaukee, St. Paul & Pacific, and the discussions indicated a marked interest in these developments.

The application of power equipment to maintence of way work was approached from an entirely different angle, in the form of a report of the committee on The Use of Motor Trucks in Track Work, which embraced much information indicating the opportunity for economies through the use of highway vehicles and the corresponding reduction in work-train service. An instructive report was also presented on recent developments in roadbed drainage.

Five Papers Were Presented

In addition to the five committee reports, papers were read on five subjects of specific interest to the maintenance of way officer. These included: Track Maintenance as Affected by Signal Operation, by R. A. Sheets, assistant signal engineer, Chicago & North Western, Chicago; Looking Ahead in Maintenance of Way, by Lem Adams, general supervisor maintenance of way, Union Pacific System, Omaha, Neb.; The Method and Organization for Laying Rail on the Pennsylvania, by R. W. E. Bowler, division engineer, Pennsylvania, Pitts-

burgh, Pa.; Safety in Maintenance, by J. E. Long, superintendent of safety, Delaware & Hudson, Albany, N. Y.; and European Track Construction and Maintenance, by J. V. Neubert, chief engineer maintenance of way, New York Central, New York.

The convention was opened with an address of welcome by L. C. Fritch, vice-president, operation, Chicago, Rock Island & Pacific. The joint report of Secretary T. F. Donahoe, general roadmaster, Baltimore & Ohio, Pittsburgh, and Treasurer James Sweeney, supervisor, Chicago & Eastern Illinois, Danville, Ill., showed that the receipts during the year exceeded the expenditures by $715, bringing the association's total assets to $5,904. The membership record showed a total membership of 943 as compared with 866 in September, 1929.

The election of officers resulted in the advance of first vice-president, Elmer T. Howson, editor, *Railway Engineering and Maintenance*, to president, and of second vice-president, C. W. Baldridge, assistant engineer, Atchison, Topeka & Santa Fe, Chicago, to first vice-president, and the election of J. J. Desmond, division engineer, Illinois Central, Chicago, to second vice-president. Mr. Donahoe and Mr. Sweeney were re-elected secretary and treasurer, respectively. B. Esbenson, general roadmaster, Union Pacific, Los Angeles & Salt Lake unit, Salt Lake City, Utah, and W. H. Sparks, general inspector of track, Chesapeake & Ohio, Russell, Ky., were elected directors for four years, and G. T. Donahue, assistant division engineer, New York Central, Watertown, N. Y., was elected director for three years to succeed Mr. Desmond.

Chicago was again chosen without opposition as the place for the next convention.

The Committee on Subjects submitted the following topics for committee work during the ensuing year:

(1) Failed rails, their cause, detection and disposition.
(2) Protection of track men working under traffic, especially in multiple-track territory and when using noise-making equipment.
(3) Water pockets, their cause and cure.
(4) Routine track inspection, its purpose, scope and value.
(5) Method of handling snow and ice on railroads including drainage of switches and other track structures where snow-melting devices are used.

The Annual Dinner

As in past years the annual dinner of the Roadmasters' and Track Supply associations was a high light of the convention. It was attended by 533 members of the two associations and members of their families, as well as by members of the Committee on Track of the American Railway Engineering Association, who held a meeting in Chicago concurrent with the convention. L. P. Shanahan, president of the Track Supply Association, acted as toastmaster and the principal speaker was S. H. Cady, general solicitor of the Chicago & North Western. A brief address was made also by Elmer T. Howson, president-elect of the Roadmasters' Association, and some unique and decidedly amusing entertainment was furnished by Axel Christianson.

Following the close of the convention on Thursday noon, the convention party visited the plants of the Illinois Steel Company and the American Steel & Wire Company at Joliet, Ill., for which they were provided with a special train by the Chicago & Alton.

Abstracts of the various reports, papers, addresses and discussions follow, together with a report of the Track Supply exhibit.

The Roadmaster and the Future of the Railways

By L. C. FRITCH
Vice-President, Operation, Chicago, Rock Island & Pacific, Chicago

L. C. Fritch

YOUR responsibilities have grown with the progress made in railway construction and operation. From the dirt track of the eighties to the well-ballasted steel highways over which massive locomotives and cars pass today at speeds of 75 to 80 miles per hour is a long way, but you have had a prominent part in this advancement, and many of the inventions and devices which make modern railway maintenance a success have been of your own making.

I cannot stress too strongly the splendid results that come from associations such as yours in the advancement of the railways. Railroading is now a science and one of the greatest factors in establishing this science has been associations such as yours. Such meetings bring out the best there is in men. Subjects are discussed and worn-out theories are discarded for tried experiments.

It was my good fortune to be connected with the organization of the American Railway Engineering Association some thirty years ago and I was at one time its president. I can say without successful contradiction that that association has done more real practical good in railway maintenance and operation than any other railway organization. It is not a competitor of your association but a worthy ally and has co-operated with you in promoting the economical and efficient construction, maintenance and operation of our railways.

It is to be regretted that the railways do not avail themselves fully of the splendid work done by such associations. After great efforts have been expended to establish standard practices and methods, these practices could be used more generally than they are with great benefit to the railways. In the establishing of standard methods and practices, your association has had a most important part. After all, "The proof of the pudding is in the eating." By actual experience you men have tried out and found out what is best. Your practical judgment is worth all the theory that can be urged in a given case.

The Age of Speed

The modern speeds required on railways, and we are in a speed age, require the very best to meet the demands of the times. With airplanes making 150 m.p.h., railway speeds of 60 to 70 m.p.h. are slow in comparison. Who knows but that the future will find the railways equipped with heavy roadbeds, larger and heavier ties, rails weighing 150 lb. or more per yard and locomotives propelled by electricity,

making speeds of 100 to 125 m.p.h. Such things are not impossible and may be required to meet the ever-increasing demand of a fierce and increasing competition.

Another adjunct to your advancement in your chosen work is the technical press, such as the *Railway Age* and other practical publications, which keep you informed of the progress being made in the art of maintaining the railways. The wider your knowledge and experience in your chosen work, the further you will advance yourself and the interests of the company which employs you.

America was built up by the railways and owes its progress and success more to the railways than to any other single factor. We who have had a part in this progress and have in a way helped to bring the railways up to their present high standard, feel a pride in our work and we strongly resent anything that tends to tear them down or cause them to deteriorate. The question that has come to me many times and to you, no doubt, is what about the future of this splendid structure which we have helped to rear and on which we so largely depend. I want to leave a few thoughts with you along this line, because you are so vitally interested, as are all railway employees. I believe that we have just as much right to protect the sacredness of our railway institution as we have the sacredness of our homes. It is our life blood and anything that affects it must affect you and those who are dependent upon you.

Many able railway men think that the railways have passed their peak and, because of the various social, economic and political forces at work, will go backward in the future, unless a determined effort is made to combat honorably the influences that are depriving them of their well-earned birthright. Other able men think that the railways will progress in the future, as in the past and look forward confidently to the time when the influences that are now seriously affecting the railways will cease by their own inertia. Between these two schools of thought are those who do not think on the subject at all and complacently fold their hands and do nothing.

When you encounter a storm, resulting in a flood on your railroad, you quickly assemble men and materials and proceed post haste to the point of danger and by the use of sandbags, rip rap and every means that you can command, you stop the encroachment of the floods upon the railroad which you have so fondly built up and cared for. Is there any difference if the railways are confronted with a menace even greater than a flood, which at the worst is but temporary, causing damage which can be repaired?

The second school of thinkers is not alarmed, but hopes that everything will eventually adjust itself through the ordinary process of economics. What that means, few people know. It may mean that after the horse is stolen we will lock the barn door. I am a believer in preparedness and would join with the first school of thinkers and prepare to meet this situation in a determined honorable manner to preserve our industry.

Do Not Know the Facts

The verdict of the American public is always right—after full knowledge of all the facts. That the American public is not familiar with all of the facts that now menace the railways is apparent, and I think it is your duty and that of every railway employee to inform them as rapidly as we can.

I will cite only one instance: The thousands of trucks that are taking an ever-increasing amount of short-haul freight from the railways are hauling the goods that you and I buy of the merchant with rail-

Earl E. Crowley

President

In view of the fact that the personnel of the Roadmasters Association consists in large part of roadmasters and supervisors, by far the greater proportion of its presidents have been chosen from among men holding supervisory positions of that rank. Earl E. Crowley is representative of that group, for, although a comparatively young man, he has been a roadmaster for 14 years. Reared in a railway atmosphere, it was but natural that he should follow the steps of his father, Dennis Crowley, for many years a roadmaster and general roadmaster on the Chicago & North Western. After serving an apprenticeship as a trackman and foreman, he served for three or four years as an assistant roadmaster on the North Western. Then, following about two years service as a roadmaster on the Santa Fe in the West, he accepted a position as roadmaster on the Delaware & Hudson in 1918, where he has remained to the present time. By reason of his broad experience, he possesses a knowledge of track work that enables him to appreciate the problems of roadmasters confronted with a wide range of climatic and physical conditions.

On Thursday Afternoon the Roadmasters Visited the Mills at Joliet

road money. Why should we not say to the merchant with whom we trade: "We get our money from the railroad and in all fairness we should not buy your goods if you haul it in by trucks, because by so doing we are destroying our own industry." If this were generally done, thousands of "fly-by-night" trucks would go out of business.

A prominent banker* of New York recently wrote an article on "A Diagnosis of Railway Ills." Coming from a profound student of the railways and containing many pertinent facts bearing upon the perils that menace our railway industry, it is interesting to consider some of the salient points in this article.

This writer believes that the short and long outlook for the railroads of the United States is far from promising and cannot improve unless the unfavorable facts are visualized and energetic joint action is taken to overcome them. Railroads, with rare exceptions, have shown very little initiative during the last generation; they have paid very close attention to detailed operating problems but have not kept ahead or even abreast of changing conditions, which during the last generation have affected nearly every walk of life and can best be faced by the railroads as a group instead of singly.

The Elements of Weakness

The writer of this article is of the opinion that the elements of weakness are as follows:

(1) Constant whittling of the rate structure, brought about to a large extent by the railroads themselves for competitive purposes.

(2) The further loss in passenger business, which during 1930 is going on at an increased rate, although this is partially due to the general decline in business and pleasure travel.

(3) The loss of profitable, as well as unprofitable, l.c.l. freight business to highway competition.

(4) In the oil-producing regions, the loss not only of crude oil, but threatened loss of much more profitable traffic in refined oil, owing to the pipe line competition.

(5) The continuing consolidation and co-ordination of various industries, eliminating wasteful competition among themselves, thus reducing the amount of competitive cross shipments.

(6) Further loss of certain commodities, or in reduced rates, owing to government subsidized waterway competition.

(7) Continued decrease in coal traffic, owing to the competition from hydro-electric development, pipe lines carrying oil and natural gas which have been constructed or are under construction to practically every city of 250,000 people or more, except certain eastern cities.

(8) Failure of the railroads to merchandise transportation properly by not adopting modern salesmanship.

(9) Railroads are suffering from cowardice in dealing with the shipping public. They lack the backbone, not only to hold up and to raise rates wherever possible, but also to insist that the cost of supplies be reduced commensurate with reductions of similar products sold to other consumers.

(10) Domination of labor through Congress. Lack of co-operation of labor organizations with the railroads to help reduce the cost of transportation.

* F. J. Lisman, *Railway Age* of August 16, page 311.

The writer points out the elements of strength, two in number, as follows:

(1) Operating efficiency demonstrated by getting better results out of every dollar spent for maintenance of way and equipment and for conducting transportation, and possibly also in connection with general expenses. This is reflected by the great reduction in fuel expenses, by the greatly increased number of ton-miles per man-hour, etc. No doubt some further progress, but at a greatly reduced rate, can be made in that direction for some years to come, but far from enough to overcome the elements of weakness above enumerated.

(2) The realization on the part of the I. C. C. of the need for increased revenue as evidenced by the recent advances in class rates in the East and Middle West, and in many other ways.

An Element of Strength

I wish to call attention to one of the elements of strength, above referred to—the element of strength in operating efficiency in both maintenance of way and equipment and conducting transportation. You men have a direct part in this and are to be congratulated upon the splendid results effected in the reduction of maintenance of way costs.

One of the great menaces to the railroads is the development of waterways. Anyone familiar with this subject, or who will take the time to investigate it, will find that there are numerous examples in the country today of money expended for waterways that have been uneconomical and will continue to be so. The railroads have the right to protect themselves against the menace of this encroachment upon their legitimate traffic. It is manifestly unfair that a government should heavily subsidize waterways by spending the peoples' money without direct benefits to the country as a whole, but only for the interests of a very few favored industries.

If every waterway project were analyzed the same as any other business is analyzed, little, if any, money would be expended on such a wasteful enterprise. One of the most glaring examples is the state barge canal of New York. This has cost the people of that state millions of dollars and placed upon the taxpayers a burden which they should not bear. To transport freight on this canal costs several times more than it does to handle this traffic by the railroads, and the railroads handle it with much greater expedition and with more benefit to all concerned.

Another menace which affects the railroads is the operation of motor trucks and buses, which are making serious inroads upon the revenues of the railroads. Is it fair to the railroads, after they have expended millions of dollars to provide roadway, structures and equipment to handle traffic, that they

should be called upon to pay taxes upon this property and, in addition thereto, be taxed for improving highways paralleling their lines, and then permit competitors to utilize such highways without bearing their just share of the burden?

This competition is most unfair and in the end the American people will not stand for it. It is your duty as railway employees to protect the interest which gives you your living; counsel with the public and tell the true story with respect to the influences which threaten the railroads, in which the public is just as much interested as you are. I am satisfied, if the American public learns the true story and knows of the attacks which are being made upon the railroads, that the sentiment would be in favor of the railroads.

In justice to the railroads, the Amercian people cannot expect them to continue to build up service as they have in the past, unless they get a square deal, which they are entitled to and should strive for.

The Equation of Track Mileage As a Basis for the Distribution of Forces

REPORT OF COMMITTEE

P. J. McAndrews
Chairman

THE subject assigned to this committee has been reported on and discussed at length at several previous conventions of this association, and in one form or another has been given serious consideration at various times by the membership of this and other associations, as well as by the directing maintenance officers on most of our railroads.

The committee believes that where conditions are fairly uniform, a plan of equated mileage may be determined that should be used as a basis for the distribution of track maintenance forces. However, we are satisfied that, because of the widely varying conditions in different parts of the countries covered by our association (in fact, climatic and physical conditions often differ more or less widely on the several divisions of a single railroad system, and sometimes even on different parts of the same division), no recommendation as to a basis for the equation of mileage or the establishment of a man-hour per mile allowance can be set up that is capable of general application.

Very rapid changes in methods of track maintenance, brought about principally through the development and adoption of labor-saving machinery in track maintenance work, constitute a potent basis for the statement that any equation of mileage arrived at under the conditions that prevailed ten or more years ago would be of little value today, and, looking to the future, it appears reasonable to assume that ten years hence the track maintenance men of America will be doing their work in ways greatly different from the practices of 1930.

A Need for Cost Accounting

A most important factor in any plan for the equating of sections and the distribution of forces on the basis of the equation is some satisfactory system of cost accounting through which the maintenance officer will be fully informed as to the man-hour costs of different phases of the work. We believe that considerable progress has been made in applying a yardstick to various items of track maintenance; we are also fully aware of the traditional efficiency of our track maintenance officers. Yet, there remains much to be desired in the development of an accurate measurement of the output per man-hour. For this reason this association should continue studies in cost accounting, this being especially desirable by reason of the adoption of expensive labor-saving machinery and improved materials and appliances.

Through questionnaires submitted to the officers of a number of railways, information has been secured indicating the satisfactory use of mileage equations on several roads. An analysis of these replies confirms our belief that where the physical condition of a property is fairly uniform, and the standard of maintenance high, with proper consideration given to the well-known fact that deferred maintenance is wasteful, an equation of mileage may easily be arrived at and used successfully as a basis for the distribution of forces. In the following abstract of replies to the questionnaire, it will be noted that about one-half of the 29 answers received show that rules for equating mileage are being used, and that of the 15 roads reporting the use of this method 14 report satisfactory results, the exception being explained in a statement to the effect that the basis employed is not the most suitable to the local conditions.

Returns Obtained Relative to Track Equation

Number of Railroads Reporting: 29

1. Is any plan of equating track mileage used on your system as a basis for distributing forces? Yes—15 No—14
2. Is such plan giving satisfactory results and has it been found advantageous? Yes—14 No—1 (disadvantageous owing to improper equation).
3. About how long has such an equation been used as a basis for distributing forces?

Years	Answers
1	1
3	1
5	1
6	1
9	1
10	3
12	2
14	1
16	1
20	1
25	1

Total Ans.—14 Not answering—1

4. Do you have a plan of cost accounting in connection with track maintenance? Yes—10 No—13

Most officers supervising track maintenance have well-considered and definite ideas on cost accounting

and the equating of track mileage, and usually apply the knowledge gained from their experience in the distribution of labor and material when granted the privilege of so doing, but there have been instances where executive officers, with ample technical knowledge but lacking in practical experience, have arbitrarily attempted to establish a basis of man-hours per mile in setting up track maintenance force allotments without sufficient consideration of local conditions, and the results in such cases have sometimes been unsatisfactory. In some instances the distribution of maintenance forces has been left in the hands of clerks who were not qualified for this important duty.

Many Variations in Practice

Because of the widely varying practices on different systems it will be found impossible to apply standards for equating mileage successfully on different railroads, some of these practices being recorded in the table appearing on this page.

Rules for Equating Mileage Reported in Replies to the Questionnaire

Index Number of Reply to Questionnaire	1*	2	3	4	5	6	7	8	9	10*	11	12	13	14	15	16	17	18†	19	20	21	22	23
Miles Second Main Track Equals 1 Mile Main Track											1											1.18	
Miles Passing Track Equal 1 Mile Main Track	2.0	3	3	3	3	3	3	2	2	2	1.1	1	2.00	2	2	2	2	2	2	3	2	2	2
Miles Yard Tracks Equal 1 Mile Main Track	3.33	1	2	1.5	1.5	2	3	3.33	3.33			1	3.33	2		2	3.33	3	2	4	2	2	3.33
Number Main Line Switches Equal 1 Mile Main Track	12	10	12	9	8	8	10	12	12	12	10		12	15	15	15	12	12	15	20	19	20	12
Number Single Slip Switches Equal 1 Mile Main Track						5		8					5						3		19	10	8
Number Double Slip Switches Equal 1 Mile Main Track	6					4		6		6			5					8	4	5	10	5	6
Number Heavy Traffic Street Crossings Equal 1 Mile Main Track	20	5	8	10-12	10	10	30	12	12	20	20		12				12	20					12
Number Light Traffic Street Crossings Equal 1 Mile Main Track	25	15	12	15-20	25	25		20	25	25	10		25				25.50	20					20
Number Single Track RR Crossings Equal 1 Mile Main Track	12	5				15	5	10		12			10					12		20		20	10
Number Double Track RR Crossings Equal 1 Mile Main Track	6	3				9		5		6													5
Do track forces maintain street and highway crossings?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes		Yes	Yes	Yes	Yes				

* On branch lines 3.33 miles of passing track, 25 heavy traffic street crossings and 50 light traffic street crossings each equal 1 mile of main track.
† On branch lines 12 miles of double slip switches equal 1 mile main track.

The maintenance of street and highway crossings is done by track forces on some systems, while on others such work, as well as fence construction and maintenance, is done by bridge and building forces.

Some systems entirely eliminate hand labor of track forces in weed destruction through the regular use of chemicals or other means.

On some railways ditching is done by machine ditchers, while on others this work is done by hand.

Some systems require track forces to perform certain duties incident to the cleaning of station buildings, etc., thus taking away from track maintenance men who have been authorized for track work.

While it may not be within the scope of this committee's report, we desire to suggest that with the present demand of the public for better and smoother street and highway crossings, some arrangement should be made to have such work done by mechanics rather than by the average section laborer, who, while skilled in track work, is often a mediocre carpenter and frequently is not furnished with the proper tools for carpenter work.

All who are familiar with track labor will agree that even with an equation of mileage which appears satisfactory, no distribution of labor based on such an equation will be proper unless the human element is given careful consideration. Thus, in some localities a considerable percentage or all of the track labor is recruited in the local community, and such laborers are usually more intelligent and capable of being developed to a higher degree of efficiency in a shorter time than the average so-called foreign laborer recruited and shipped out from a labor center.

Any attempted equation of mileage as a basis for the distribution of forces must of necessity give consideration also to the physical condition of the roadbed and track, including the weight of rail, the kind and condition of the ballast, the density of traffic (and the consequent interference with the work), the speed of traffic, grade conditions, etc. When such conditions are fairly uniform on a division or group of divisions, it should not be difficult and certainly not impossible to arrive at an equation that will equalize the work required per man-hour to maintain track at the desired standard.

Among the difficulties that will be encountered in an attempt to make any equation of general application, the following will be found important:

The greatly varying number of annual tie renewals, ranging from less than 100 to more than 200 per mile.

The higher standards of joint maintenance on some systems, through continued use of approved methods for building up battered rail ends.

The more general use of labor-saving machinery, etc.

The lack of sufficient supervisory officers and assistants, resulting in the slow education and development of foremen and laborers.

The lack of standardization or approved efficient methods of performing different items of work.

The equation of mileage in yards must of necessity include careful consideration of traffic density, age of tracks, weight and condition of rail and ballast, seasonal changes in business which might permit work to be done at a time of lessened interference from traffic, or in yards of some reserve capacity when tracks can be given over during the time necessary for periodic maintenance work.

Conclusions

The committee suggests a more extended use of approved cost accounting methods as an aid in the programming of work, and the establishment of a workable equation of mileage units as a basis in

the distribution of track maintenance forces.

We recommend a careful analysis of the results being secured through the use of labor-saving devices, and the effect that such devices are having in raising the standard of maintenance work.

Appendix

Abstract from Replies to Questionnaire

"On the Salt Lake division, the allowance is 0.710 men per mile of main line main track during the active working season and 0.485 during the season when maintenance is curtailed due to the extremely cold weather in the mountain territory; on the Los Angeles division, the allowance is 0.648 men per mile of main line main track during the working season and 0.460 men during the off season when maintenance is curtailed to avoid loss in efficiency of labor during the extremely hot weather in the desert territory."—R. E. Adamson, chief engineer, L. A. & S. L. Unit of the U. P. System.

"Owing to the use of treated ties and other improvements, we have been lengthening sections for the last three years without regard to equation factors, but we think this plan will be a means of making corrections in territory, etc., later on."—J. B. Kelly, general roadmaster, M. St. P. & S. S. M.

"A statement was made up showing the comparative strength of various track sections, but it was found that the figures were valueless on account of the wide variations in characteristics of the various sections."—G. B. Alexander, division engineer, C. P. R.

"Our methods of doing track maintenance are bound to change very rapidly in the next few years on account of the power-driven tools and machines that will be available for this work. After July 15 we will have about 1,200 men, in gangs of from 75 to 125 men, doing the maintenance work that ordinary section crews have done heretofore. These outfits are provided with every modern power-driven tool and machine that we think has any merits. We think that within five years our section crews will be provided with very light motor cars and consist of not to exceed two laborers and a foreman, and that they will cover more territory than they do now and serve primarily as inspectors. They will not have to renew any ties, surface track or do the heavy work that section crews now do by hand. If this plan can be perfected there will be no need for the information that your questionnaire calls for."—W. Shea, assistant engineer maintenance of way, C. M. St. P. & P.

"On page 1136 of the proceedings of the American Railway Engineering Association, Vol. 30, is a recommendation of a committee of 10 railway engineers for equating track mileage as reported in Appendix

Elmer T. Howson
First Vice-President

T. F. Donahoe
Secretary

Roadmasters' Association

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(Terms Expire September, 1930.)

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E. P. SAFFORD, Supervisor, N. Y. C., Silver Creek, N. Y.

C. W. Baldridge
Second Vice-President

James Sweeney
Treasurer

'C' in the study of economics of railway labor:

"One mile of first main track is equivalent to:

1.15 miles of second main track,
1.33 miles of third of four main track,
2.00 miles of branch-line track,
2.00 miles of passing and thoroughfare track,
3.33 miles of yard track,
13 main-track switches,
20 side-track switches.

Some of the roads include other items, such as railroad crossings, city street crossings, country road crossings, track pans, ditches, fences, interlocking plants, derails, station grounds, water and fuel stations, stock pens and chutes, slides, etc., which are assigned various equivalent values. Experiments in this direction are now being made on one of our roadmaster's districts and will shortly be made on one or two more."—W. R. Armstrong, general superintendent, L. S. & S. L. Unit of the U. P. System.

"It is not practical to distribute forces on the basis of equated mileage as now computed, particularly in the northwest, for conditions vary too greatly. Equated mileage does not consider such varying conditions as traffic, ballast, weight of rail, proximity of track to rivers or bluffs, etc."—C. W. Coil, roadmaster, N. P.

"We give some weight to a rather simple form of equated mileage, but at best it must be used with judgment and discretion. Physical and traffic conditions make wide differences in different sections of tracks. I believe that the more items that are added to the formula, the more complicated and difficult it becomes, owing to the inequality that exists in the same items. I have always doubted whether any exact formula could be worked out that can be applied literally. Something might be devised that would be a good aid but in the end is it not the judgment of the roadmaster and engineer that must count? The amount of force allowed depends entirely upon business conditions and a good formula may be an aid in allotting it if used with judgment and discretion."—J. B. Martin, gen. insp., track, N. Y. C.

Committee: P. J. McAndrews, chairman, roadmaster, C. & N. W., Sterling, Ill.; C. E. Anderson, roadmaster, C. B. & Q., Burlington, Iowa; H. B. Bachrach, supervisor, D. & H., Schenectady, N. Y.; J. M. Gamble, roadmaster, S. A. L., Savannah, Ga.; B. E. Hailey, general roadmaster, A. C. L., Lakeland, Fla.; W. S. Hofford, roadmaster's clerk, L. A. & S. L., Los Angeles, Cal.; F. H. Masters, acting chief engineer, E. J. & E., Joliet, Ill.; T. P. O'Neill, engineer maintenance of way, C. & S., Denver, Colo.; H. A. Powell, office engineer, Central Indiana, Anderson, Ind.; Robert Yost, roadmaster, A. T. & S. F., Chillicothe, Ill.

Discussion

Replying to a question raised by James Sweeney (C. & E. I.) concerning the influence of the weight of rail, Mr. McAndrews stressed the influence which this factor exerts on the equating of mileage. Obviously, he said, track laid with 130-lb. rail will not require as large a force as track carrying the same traffic that is laid with 80-lb. rail. Answering Elmer T. Howson *(Railway Engineering and Maintenance)*, who raised the question as to the influence of the various physical features of a section, he said that a method of equating track mileage is necessary but that in the opinion of the committee it should be applied by the supervisor to his own forces rather than to have an equation set up to apply to the system arbitrarily. It is a privilege that the supervisor should have as he is best able to exercise it. This thought was expressed emphatically by Mr. Howson who said that if a man must carry the responsibility for track maintenance, he must also be given the authority to distribute and direct the forces.

J. P. Corcoran (C. & A.) stated that on the Chicago & Alton the number of men assigned to a supervisor is determined on the basis of a certain number of men per section but that the supervisor has authority to re-assign the men to the various foremen in accordance with the dictates of his own judgment.

Considerable discussion centered around the question of the equation of switches, particularly switches in heavy yard leads. In the opinion of President Crowley, 20 yard switches involved much more work than a mile of main track and much more work than 13 main-track switches. This view was endorsed by Mr. Corcoran who explained that the primary reason for the large labor output in maintaining yard switches arises from the inability to work on them without an enormous waste of time. This point was taken up at length by Mr. McAndrews who recalled with what "holy horror" the operating department received the first suggestion that main tracks be taken out of service for the conduct of major renewal programs. Such suggestions were met at first with the rejoinder that "it can't be done." Nevertheless it has been demonstrated that it can be done and is now being done generally. In his opinion it is time that officers of track maintenance take the same position with reference to the maintenance of yard tracks and switches.

In discussing the equating of yard switches, H. R. Clarke (C. B. & Q.) pointed out that the same standard of maintenance is not expected on yard-track switches as on main-track switches. He also called attention to other factors that influence the allocation of forces which must necessarily be left to the supervisor or roadmaster. Rather than expect the roadmaster to adhere to a fixed distribution of the men to the various sections, it is his opinion that an even distribution of the men to the sections is a very good indication that a roadmaster is not properly supervising his force. He definitely endorsed Mr. McAndrews' stand that the supervisor should have the authority as well as the responsibility.

While it was generally agreed that the allocation of the men to the various sections should be left entirely to the supervisory officer, C. A. Geiger (N. Y. C.) called attention to conditions under which this does not entirely solve the problem for the roadmaster or supervisor. In the event that the supervisor's territory consists very largely of terminals, the failure to take into account the equation of track mileage in the distribution of forces to the various districts may easily result in the supplying of an inadequate force to the subdivision that embraces a large number of the supplemental items such as side tracks, yard tracks, switches, etc.

J. J. Desmond (I. C.) raised a question with respect to the transfer of the maintenance of highway crossings and wooden fences to the bridge and building forces and wondered if this would not result in a division of responsibility but Mr. McAndrews called attention to the fact that this arrangement in no way differed from that which is encountered on all bridges, where the bridge forces are charged with most of the maintenance work but the track department is responsible for the safety of the track. Mr. Sweeney felt that the construction of rail crossings should be handled by track forces in all cases. An interesting variance from conventional practice was outlined by P. Pheney (U. P.) on the Los Angeles & Salt Lake unit of the Union Pacific in the vicinity of Los Angeles. Plank crossings are maintained by a bridge gang but track forces are required to put on and maintain a surface of bituminous material where this is provided. In addition, a small highway-crossing gang is employed to put in all asphalt and concrete crossings and he reported that better results have been

obtained by this organization than where the track gangs handle all crossing installation and maintenance.

The discussion of the report of the committee reverted on several occasions to the new forms of track maintenance organization now in vogue on the Chicago, Milwaukee, St. Paul & Pacific and the Great Northern, the subject being introduced by William Shea (C. M. St. P. & P.) who contended that changes in organization such as that being carried out by the Milwaukee would result in the upsetting of current systems of equating mileage. This subject, however, was discussed at length following the presentation of the report of the Committee on Division of Work Between Section and Extra Gangs.

Track Maintenance As Affected by Signal Operation

By R. A. SHEETS
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THE SIGNAL departments of the various railroads in the United States have grown up in the last 20 years from departments to which were assigned primarily the duty of surrounding train movements with protection, to departments which must devise, install and maintain devices for expediting train movements to promote efficiency and economy in train operation. About the only facility now installed purely for reasons of safety is highway crossing protection and even that can be translated into a dollars-and-cents investment. Safety of operation is not always the prime motive for the installation of signals or signaling devices although it must be an inherent quality of such installations.

Signal departments of all railroads are working more closely with the operating departments and we are less concerned today with batteries and wires than we are with such operating problems as train-miles per hour and gross ton-miles per train-hour. Every signal installation, every interlocking plant or every highway crossing signal must be considered from the standpoint of its effect upon operating expense. It appears that railroads today are operated at too great a cost for the amount of business done. Some of the measures for cutting down such operating costs are to eliminate unnecessary train stops at crossings and junctions, to expedite the movement of trains so that the freight or passenger traffic can be moved to destination quickly, and to eliminate unnecessary man power for the operation of signals, for handling train orders, etc.

Every installation must be carefully estimated and analyzed to show that the savings over and above interest and depreciation will be equal to or in excess of 20 per cent annually on the investment. An analysis covering only seven years on the railroad with which I am connected, shows that the signal department has installed devices which have made possible annual savings in operation amounting to $625,000 annually. Of this saving, $440,000 is due to signals and interlocking and $185,000 to highway crossing protection.

Must Operate as Intended

All of this means but one thing and that is that these installations, which are basically electrical in their operation and automatic in their functions, must be guaranteed to operate as intended. The signal department can install all the wires and other apparatus but the proper operation rests directly upon the maintenance of the track over which the trains move.

No matter how large the rail or how well maintained, it is necessary for the proper operation of automatic signaling devices that every rail joint be bonded. The small electric current that flows through the rail for the operation of the automatic signal control cannot be guaranteed to pass through the angle bars at the joint and some sort of a bond must therefore be placed from rail to rail around the angle bars. Iron bond wires were originally installed for this purpose but because of the difficulties due to rusting and interference with proper track maintenance, they are gradually being replaced by a type of bond which is welded directly to the ball of the rail. These welded bonds and other types of cable bonds cost in the neighborhood of 30 cents to 40 cents per joint applied. It should be evident that, if a railroad company can afford to spend this much money on every rail joint, an unbonded joint is something serious and that it is just as much the duty of a track man to report an unbonded joint which may cause the unnecessary stopping of trains as it is for him to require the proper bonding of a new rail when it is installed.

No matter how expensive an installation of signaling devices has been provided, and no matter how well the rails are bonded, it is impossible to guarantee proper operation of signals unless the track ballast is properly drained. Poor drainage, of course, is reflected in poor track surface and in heavy costs for track maintenance, but, in addition, such poor drainage is probably responsible in wet weather for more unnecessary train stops than any other one thing. Although every automatic-signal track circuit has been supplied with a storage battery or its equivalent and, although these batteries are of sufficient size to crank an automobile or operate a radio set, it must be understood that nearly all of this electrical energy leaks away and scarcely enough remains in the rails under the best of conditions to operate the most efficient apparatus that can be designed for signal control.

When it is understood that the circuit applied at one end of the track circuit must flow down one rail and back through the other to operate the signaling devices properly and that these rails touch the ground at every foot of their length and that it is the tendency of the battery energy to cut across from rail to rail instead of going to the place desired, it should be self-evident that water, salt brine, zinc-treated ties, mud and any dirt has a tendency to promote this leakage. Too much battery current, on the other hand, may result in false-clear signals, therefore all a maintainer can do is apply current up to the limit and hope it won't rain at night until the track man cleans out the mud.

Switch Operation

In order to provide the proper safety factor in the operation of automatic signals it is necessary that the signal circuits be connected through switch-circuit controllers which will check the position of all switch points in main track. When it is considered that a switch with the point open ¼ in. is a menace to safe train operation and that the signal must indicate stop under such conditions, it is quite evident that the adjustment of these circuit controllers is very important. The track foreman can quite easily throw such delicate adjustment out of order by the most incidental of repairs to switch points or stands. Although he may not put the signal out of order, the circuit controller may be

put out of adjustment to such an extent that the switch point could stand open on account of a bent point and still cause the signal to remain clear. It should, therefore, be the duty of every track foreman, when working around switches in signal territory, to require an inspection of the switch-circuit controllers by the signal maintainer.

It seems to be generally understood that track men will co-operate with the signal maintainer when working around switches at an interlocking plant, but in view of the increasing number of installations of power-operated switches at remote points, which are really interlocked switches, the track man should call upon the signal maintainer for an inspection of such switches, even though his work consisted only of tamping up a tie or tightening a rail brace. These switches are checked by a lock bar connected to the point, and the signal maintainer is allowed only ⅛ in. clearance to provide for the moving of the points. Failures and train delays can, therefore, easily result from a lack of co-operation, even if the bushings have been left in the heel of the points.

Pipe-connected derails are generally installed in connection with main-line switches in automatic signal territory because they afford fouling protection for the main line. It can best be secured in this manner and it is very important that such derails be kept in order and operated properly. There is no reason why the track foreman, when oiling a switch, should not drop a little oil on a derail and should not otherwise share some responsibility in connection with its proper maintenance.

Insulated Joints

There is one point of contact betwen the signal and the track departments which is of the most vital importance and which perhaps causes the most friction. No matter how expensive the signal installation or how important it is in the scheme of railroad operation, or how well it is maintained by the signal department, it cannot be a success unless the insulated joints are properly installed and maintained. Automatic signaling, highway-crossing protection, automatic train control, electric route protection at interlocking plants, all depend primarily for their proper functioning upon the separation of certain sections of track from certain other sections of track. Angle bars with fibre surrounding the ends of the rails provide the only practical scheme for making this separation.

We all agree that an insulated joint is the weakest spot in the signaling system and that it will cause much difficulty in track maintenance, but it is a necessity and, so far as I can see, a problem that we will always have with us. Most railroads purchase the best of material, therefore, proper maintenance is the only remedy for our difficulty with these joints. Most track men do not really understand that a broken-down insulated joint due to a crushed end post or worn fibre or damaged bushings may produce a potentially unsafe condition. The fact that such a condition did not cause trouble at some particular point, should not be taken as any reason for negligence in properly maintaining joints at another location.

I will agree that many insulated joints are installed in tracks, particularly sidings, which do not seem to have any definite purpose and some do not under ordinary circumstances, but when it is understood that stray or foreign currents of electrical energy are flowing around through the earth and through unbonded tracks as well as bonded ones, it should not be difficult for anyone to understand that insulated joints are installed not only to keep the signal energy from flowing away, but also to keep any of this unwanted energy from flowing in.

Insulated-joint maintenance can be greatly reduced if the joints are properly and carefully assembled and the steel is properly anchored to relieve them of undue strain. The joints themselves should not be anchored. Bolts should not be driven through or bent in order to get them in place, but the whole joint should be looked at as a piece of apparatus costing the railroad about $12 and, if properly installed, should be good for approximately a year in main track, and considerably longer in secondary track. If roadmasters and trackmen would look at these joints as a necessary evil, provide the proper tools and equipment for installing and repairing them and make the same effort to keep them in good condition that they do in keping up other parts of the track, I believe this problem would settle itself automatically. In this connection, I wish to advise that a recent test of rail expanders on my railroad has shown that they are very desirable for use in the proper maintenance of these joints and no doubt will soon be furnished as regular equipment.

With these few comments on the main points of contact between the two departments, I believe you will agree that there is nothing in the signal requirements which should afford any justification for friction between signal maintainers and track foremen. I will agree that signal maintainers are sometimes unreasonable in requesting track foremen to make emergency repairs, but the responsibility for signal failures must of necessity rest directly on the signal maintainer. Track foremen are considered competent and qualified and if properly backed up by the roadmasters, I am sure that they would ordinarily take care of many maintenance renewals without any direct suggestions from the signal maintainer. Too often, however, track foremen feel that this signal maintenance is not a regular part of their duties, but, obviously, this attitude can only be explained by the failure of the roadmaster to provide properly for such work in his track maintenance allowance.

Get Better Acquainted

As a concluding thought, may I suggest that signal supervisors and roadmasters become better acquainted, to the end that neither will feel that the other is trying to put something over. There is no occasion for a signal supervisor to become angry with a roadmaster because the latter cannot get sufficient funds to clean up or properly drain a piece of track; neither should a roadmaster become incensed at a signal supervisor because the installation of highway crossing signals or electric route locking at an interlocking plant requires the installation of many extra insulated joints. If they become well enough acquainted, they will understand each others' problems and can, perhaps, take them to the superintendent or other supervisory officer for the necessary adjustment and payroll allowance. There is nothing better than personal contact.

Signals are installed for the purpose of effecting some economy, as well as for promoting safety, and anyone neglecting his work or permitting conditions to exist which would in any way detract from the economy or safety of an installation is not only responsible for the direct loss resulting therefrom, but is morally responsible for the temporary failure of the entire system or installation. A train stop, brought about because a switch is out of adjustment or because a bond wire is broken off or an insulated joint has broken down, represents, in round figures, a loss of $2 to any railroad, and it can readily be seen that the unnecessary stopping of two or three trains and the calling out of a signal

maintainer to investigate the trouble and then the calling of the trackmen to make the repairs would result in a direct financial loss to the company of from $15 $50. When this is multiplied by similar occurrences on several divisions, the total loss is considerable, in fact, more than enough in many cases to have properly maintained all of the devices on some one division.

What a pleasure it is to ride a high-class train over a division with well-ballasted track, with heavy rail; over switches and junctions protected with interlocking, over tracks protected by automatic signals or automatic train control, over highway crossings protected with automatic signals, and all this, safely, at high speed, and without delay or inconvenience from any source. What a feeling of chagrin comes over one if even the slightest failure interferes and the train is unnecessarily delayed. How real is this feeling to the one responsible for the cause of the delay. That is one reason why I have always felt that a signal maintainer or a track foreman should be required periodically to ride over his district on one of the crack trains, hoping that through some fortunate circumstance, he might experience both feelings.

Discussion

James Sweeney (C. & E. I.) stated that formerly the life of insulated joints did not exceed six months but that better maintenance, coupled with improved materials, has extended the life of such joints on his road to a maximum of five to six years. J. J. Desmond (I. C.) inquired as to the best system of providing insulating material for the section foremen. Mr. Sheets replied that the most satisfactory system is to require the signal maintainer to order this material since he has a better knowledge of all of the requirements and the technical terms involved. As soon as it arrives, he distributes about half of the consignment to the several foremen on his territory, retaining the remainder as a reserve supply. J. P. Corcoran (C. & A.) asked what should be done in case the end flow of the rails at the joint is sufficient to complete the circuit across the insulated gap. In reply Mr. Sheets placed the responsibility for the maintenance of insulated joints primarily with the signal maintainer, stating that he should inspect and mark defects in a manner that is intelligible to the foremen. The foremen should then make the repairs.

J. F. McConahay (signal supervisor C. M. St. P. & P.) said that on the Milwaukee parkway cable had been substituted for trunking, since insulated joints are more difficult to maintain where the latter is used. Friction between the track and signal forces has been eliminated by requiring a joint inspection of switches and insulated joints by the section foreman and signal maintainer. About four times a year the signal supervisor and roadmaster are present during this inspection so that all differences are ironed out on the ground.

Looking Ahead in Maintenance of Way Work

By LEM ADAMS
General Supervisor Maintenance of Way, Union Pacific System.

Lem Adams

IN THIS new era of railroading, we should pause to consider what is before us. New conditions have developed as the result of added means of transportation—the automobile, the bus, the truck, and the aeroplane, which have not only affected our traffic, but have required us to speed up our trains. We are living in a "speed age." Thus we find ourselves faced with greater demands upon our track structure, and less money to keep it up. This is the picture that confronts us as we look into the future of track maintenance.

A few days ago, I read an article which even predicted the end of railroad transportation during the present century; so it seems that our very existence is not secure. However, we are living in the greatest of all transportation ages, and we shall see a wonderful development in maintenance of way methods within the next ten years.

We will assume that a proper track structure is provided, with a good, well drained roadbed, an adequate depth and proper quality of ballast, sufficient ties to carry the load, and heavy rail to reduce shock and vibration. Then we have the problem of maintaining the track to proper line and surface, at the lowest possible cost. But this cannot be done by the old hand-tool method under which most of us have been reared. We must turn to machinery to carry the burden of, and to speed up, our work. However, machines are expensive, and maintenance of way men have been somewhat backward in recognizing the benefits to be derived from machinery in track work. Further, we cannot convert our methods all at once, but must plan to get the most work possible from the number of machines available.

Is our present track organization best adapted for doing our major work with machinery? For miscellaneous spotting, policing and patrol, we must have a basic section force, but I see ahead of us the larger gang organization, with machines, not hand tools, for doing all the heavy work. Rail renewals and ballast work are now largely so handled, but we have overlooked our largest single item of maintenance of way expense—the crosstie.

Tie renewals are generally made early in the year, so that they will be bedded down before the fall freeze-up. Why not tamp them up properly at once by having them renewed by a small specialized gang equipped with power tampers? Let the section foreman mark the ties to come out, and his small gang dress up the track after the renewals are made. In this way, I think that we will have a better track and the cost of renewal will be much less than when done by the regular section men, many of whom do not stay on the job long enough to learn how to tamp a tie properly.

A New Maintenance Organization

The Chicago, Milwaukee, St. Paul and Pacific, largely through the efforts of William Shea, assistant engineer maintenance of way, has done some very effective work with large gangs fully equipped with machinery, and that road, I understand, has so thoroughly demonstrated the economy of the plan that it is extending the practice over a great portion of its lines. I expect the extra gang

to replace the section gang for all but regular housekeeping on the section, and this work will require a small gang indeed.

We cannot expect that machines are going to get the desired results unless we give them close supervision. They are all designed for a certain work, and it is up to us to get the maximum production out of them; and not be satisfied if we are barely doing our job cheaper than by hand methods. Machine work should be much more economical, and more uniform. Find out what the maximum performance is for each machine you have, and insist upon obtaining that each day.

Track Work Can Be Scheduled

We too often hear that track conditions are so varied that definite units of production cannot be obtained. This is only an alibi for the man who does not know his job. Track work can be scheduled the same as any other, so let's get the habit of thinking in units of work, rather than men, and make *performance* our slogan.

Bear in mind that machines of any kind will not be operated skillfully by the so-called common laborer. We must train men as operators, and see that they are retained in service during the winter months (where you cannot keep them employed the year around) in order to have them on hand the following season. But, of course, we want to keep all machines working during as many of the twelve months as practicable, so figure out for yourself other jobs that your machine will handle more economically than if done by hand. In short, whenever you have work at hand, think of a machine that will help you to get it done quickly, and at the least expense.

Avoid sidetracking machinery that is furnished you because your foremen do not know how to use it effectively. See that they are taught how to use it. I recently heard of a rail-renewal gang that had been provided with several labor-saving devices and had only the rail crane in service—the foreman thought that their use slowed up his work.

It was only a few years ago that we accepted rail batter as inevitable, and considered that nothing could be done about it, while now most of us build up the worn ends to prolong rail life, and would regard it almost criminal to renew rail simply because of batter. In this connection, I recently witnessed the test of a tool that will very cheaply cut out the end overflow produced in cold rolling new rail, and, I think, greatly retard batter.

Thus we find something new being developed almost constantly. The supply man is here to help us with our problems, and the manufacturers are constantly working to develop new machines which will reduce the cost of our work.

Our problem is to keep up the property at the lowest possible cost, rather than maintain the best track possible regardless of expense. Think of your work in terms of money, and then spend it as if it were your own. You will find that you can cut down many items of expense that will aggregate a great deal of money. Eliminate unnecessary work, and know at all times that your men are doing something constructive, and for the betterment of your track or the required appearance of the property. Some of our maintenance engineers will say that it is their job to figure out the money, and yours to do the work, but it is my thought that *you* are the men that can save the money by getting your work done in the most economical way.

This was not intended as a sermon on economics, but to outline to you the roadmaster's place in the future scheme of track maintenance, and I know that you can always be depended upon to carry your share of the load, as you have done so admirably in the past.

Getting the Most from Labor-Saving Equipment

REPORT OF COMMITTEE

W. O. Frame
Chairman

WHEN WE take into consideration the fact that Class I railroads are carrying an investment in labor-saving equipment of approximately $420,000,000 and that the interest charges on the investment, the depreciation and the cost of repairs annually amount to $75,000,000, it is apparent that, in order to realize a satisfactory return on the investment, every one connected with railway maintenance, from the foremen up to the executive officers, must give very careful thought to the selection, handling and maintenance of work equipment.

This committee has endeavored to confine its study as near as possible to the subject assigned and will not make any recommendations as to the amount of labor-saving equipment needed by a railroad, assuming that each railroad knows its own needs best.

When a close study is made of the problem, it divides itself into six major topics, each bearing a close relation to the others, but each presenting a problem somewhat individual and distinctive. This committee feels that each is equally important and that to get the most out of work equipment it will be necessary to:

1. Carefully select equipment suited to the requirements.
2. Prepare a comprehensive program covering the work to be done by the equipment.
3. Properly organize the handling of work equipment in the field to secure maximum efficiency.
4. Maintain equipment in first-class condition.
5. Make dual use of equipment.
6. Educate maintenance-of-way employees as to the value of and proper use of labor-saving equipment.

Further on in this report we will discuss the problems presented under these various subdivisions and offer recommendations.

(1) Selection

The selection of work equipment should never be a one-man job. We feel safe in saying that many maintenance-of-way officers on most railroads have been confronted with the problem of trying to produce results with equipment that was not properly designed to do the work that was expected of it and that in such cases the subordinate employees and even the officers have often become discouraged and reluctant to give other labor-saving machinery a fair

trial. The design of a machine satisfactory for use in railway maintenance demands ruggedness of construction and simplicity, together with standardization and interchangeability of parts wherever possible, with simplicity of operation and maintenance.

The growth in the use of labor-saving machinery on American railroads has been rapid and as a result there has been a gradual decrease in the number of common and unskilled laborers employed and an increase in more skilled and intelligent labor and supervision. Yet, at peak times during our maintenance season, we still have difficulty in securing enough entirely competent work-equipment operators and are forced to use men who have had only a small amount of mechanical training. This is particularly true of the operators of the minor roadway machines which are not kept busy the entire year and to which oftentimes no regular operator is assigned. Under this condition we are going to get better performance from the more rugged and simply-operated machine.

Standardization and interchangeability of parts are particularly vital necessities in both the maintenance and operation of roadway equipment. As this is worked out, it will mean that we will be able to reduce greatly the stock of repair parts now carried and can make greater use of parts salvaged from worn out machines when they are dismantled. Many delays due to breakdowns could be saved by borrowing parts from machines that are idle to make emergency repairs to a disabled machine when such parts are interchangeable. To be fair with the railroads and for their own interest, we feel that the manufacturers of work equipment for use on railways would do well to give the matter of further standardization of parts close study.

In selecting equipment, the initial cost is also to be considered. To insure that no mistake is made in selecting proper equipment to be purchased, we recommend that this matter be handled by a committee consisting of a representative of the mechanical department, the supervisor of work equipment and the system officer in charge of track maintenance. Such a committee should be able to determine if the machine is mechanically correct, can be economically maintained and is adapted to the class of service for which it is needed.

(2) A Working Program

To insure the maximum output from roadway machines, it is necessary that the work to be performed by them be planned and that a comprehensive program be worked up sufficiently in advance so that all concerned will know just what is to be done and at about what time.

Generally the work performed by roadway machines is only a part of a large amount of work, other parts of the project to be done by hand, but almost without exception that part performed by machinery is the opening wedge or keynote to the entire job. For example, a pile driver will be employed on three or four operating divisions, driving piling for bridges over several hundred miles throughout the season and working on a program which if disrupted would involve and delay the schedule of several bridge gangs. The steam ditcher affords another good example. This equipment is being used quite generally to secure dirt for bank widening which as a rule is done in connection with ballasting. With the work carefully programmed, a pair of ditchers will insure that the bank widening is completed well in advance of several ballasting gangs.

If the equipment is to be worked on only one division a program prepared by the division officer in charge of maintenance is sufficient. If it is to work on more than one division a list of the work to be done showing the date the equipment is wanted and the time it will be required should be made up by the division officers in charge of maintenance and submitted to the district officer in charge of maintenance who will program the work to be done on the district.

There is certain major equipment such as steam shovels, pile drivers, track oilers, ballast cleaners, chemical weed destroyers, etc., which are operated over a grand division or the entire system, that should have their work programmed from the general office, usually by the general manager, chief engineer

The Work of Large Machines Must Be Planned

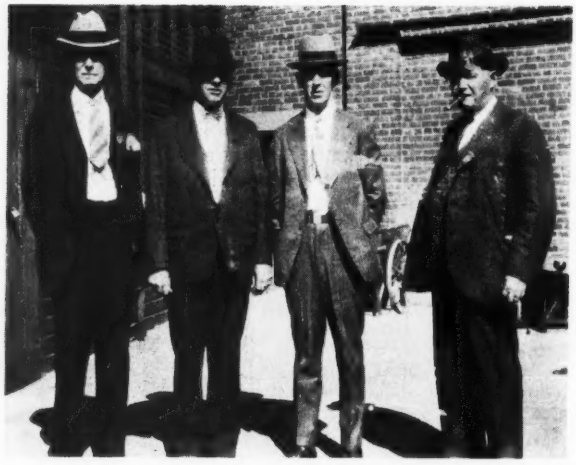
maintenance-of-way and chief bridge engineer, who work up their programs from information furnished by the district officers in charge of maintenance. When programming work it should always be kept in mind that by spreading out the work where it is economical to do so over a greater period, a smaller investment in equipment will be required.

(3) Field Organization

To a very large degree, the results we secure from work equipment are dependent on the field officer who supervises maintenance-of-way work, namely, the roadmaster, supervisor or division engineer. We will assume the officer in charge of maintenance has a definite program covering just what is to be done before the equipment is furnished him. He should also know what the equipment is costing him daily. One of the principal leaks in the operation of work equipment is time paid for when no actual work is done by equipment, which is usually the time consumed repairing machinery, taking supplies and delays due to traffic and to traveling to and from work. The right kind of an organization will eliminate these delays to a surprising extent. Work equipment should be tied up as close to the point where work is to be done as possible. In order to do this it is usually necessary to make special arrangements such as double-tanking locomotives on work trains, providing engine watchmen and perhaps outfit cars for the use of employees.

(4) Adequate Equipment Maintenance

In order to insure satisfactory performance and secure the maximum life from work equipment it is essential that it be properly maintained and kept in good repair. An organization to handle this part of the work is quite necessary and we feel that for a



Four Past Presidents—James Sweeney, J. B. Kelly, E. E. Crowley and P. J. McAndrews

railroad owning a normal amount of work equipment, the organization for handling the maintenance and repairs should be built up on the following lines:

There should be a system supervisor of work equipment whose duty it should be to assist in selecting the equipment to be purchased, to keep a record of performance and cost of repairs, to employ operators and generally supervise the distribution of the equipment to be sure it is adapted to perform the service required of it. An assistant to the supervisor of work equipment (or more than one if necessary) should be provided to serve as a field inspector and should have a good, practical knowledge of the equipment so as to be able to instruct operators properly. His services are very valuable in breaking in the younger operators. He will be in a position to inspect the equipment frequently, see that it is being properly maintained, that a sufficient stock of emergency repair parts is being carried, inspect equipment when idle and arrange for repairs to be made so it will be serviceable when needed.

A canvass of 10 railroads showed that the general practice of handling the shopping or general repairs to equipment is to send it to the shop at the end of the working season and have the operator in charge accompany the machine and assist shop mechanics in making repairs. Advice as to repairs needed is furnished by supervisor of work equipment, although in most cases the repair forces work under the supervision of the master mechanic or shop superintendent.

We feel that, in general, the practice just outlined is to be recommended. To the railroads who have not yet followed the practice of using the work equipment operators, particularly those in charge of the major machines during the slack season in assisting in making general repairs to machines, we suggest they give it a trial. This means steady employment for the entire year to the highest class of operators and assists materially in qualifying them mechanically so that they can take care of most of the repair jobs in the field during the working season and affords an opportunity to them to know thoroughly the machine they are operating.

Work-equipment operators should make periodical reports to the supervisor of work equipment as to the condition of the equipment but in cases where emergency repairs are needed the matter should be handled by wire. While we have recommended that the supervisor of work equipment employ the operators, it is felt that operators should be responsible to the maintenance officer who is in direct charge of the work being done.

(5) Intensive Use of Machines

Our study of the work equipment situation on a number of railroads leads us to believe that much can be done to increase the number of working days of maintenance machines during the season by making dual use of them. Throughout the greater part of the United States and Canada, the period during which maintenance and construction work can be successfully handled will not exceed seven months and is in many cases less than this. This means that if we are able to keep the equipment busy on the work for which it was primarily intended, it will be idle about five months each year. Of the work equipment owned by Class I railroads today there are many types which may be studied with a view to increasing their working time by dual use. Compressors which are a part of pneumatic tie tamping and spiking and bolting outfits can generally be used to good advantage by the bridge and building forces in riveting, tearing out masonry, concrete, etc. The steel spreader and spreader-ditchers are excellently adapted for use in clearing snow and ice from tracks and they generally give better results than regular snow plows. The steam ditcher can be used with good success in loading rail, and many other units of equipment can be put to different uses.

When diverting work equipment to uses other than those for which it was intended, it is often necessary to add to it some additional appliance; for example, our modern rail-laying cranes, when equipped with a clamshell bucket, can be used to good advantage in connection with ballasting, building subgrade, skeletonizing track and equalizing ballast, and, in the off-season period for maintenance, can be kept busy around terminal yards in loading material, cleaning cinder pits, etc., work that they could not handle without the clamshell attachment. The expense of adding these extra appliances is only a small part of the cost of the machine and is usually well justified.

The variety of uses, of course, can be overdone. We would not want to tie up a compressor with a paint-spraying outfit and have a ballasting gang tamping by hand due to the lack of the compressor, but with the equipment properly supervised, these errors will be avoided.

(6) Education of Employees

We can say without any hesitation that this is a machine age, and in no line of industry is the burden of work being shifted from human muscles to machinery more rapidly than among the railroads and in no branch of railway industry is the change proceeding more quickly than in construction and maintenance-of-way work.

The introduction of this equipment has necessitated important changes in the methods and practices which have been followed heretofore in handling maintenance-of-way and construction work. These changes when made have not always met with favor on the part of the foremen and some of the supervisory officers. When we remember that many of those who are our officers and foremen today acquired considerable of their experience in a day when manual means rather than mechanical were employed to do the work, this is not surprising, and one of the problems before maintenance-of-way officers today

is to educate the men upon whom falls the task of producing results in the proper use of the equipment and in the advantage of its use.

To the man who is reluctant to take to the use of labor-saving devices, education should be directed in a patient, tactful way, rather than by force of authority. A good, plain discussion of the matter between the supervisory officer and foreman, we feel, will generally accomplish more toward securing the foreman's co-operation and best efforts to get desired performance out of equipment than any amount of written instructions.

It should be remembered that with very few exceptions maintenance-of-way employees in a supervisory capacity have been in the service several years and have earned their promotions through loyalty and their ability to handle work in a satisfactory manner, and it is fair to assume that any obstinacy they show toward the use of work equipment is due to a lack of understanding.

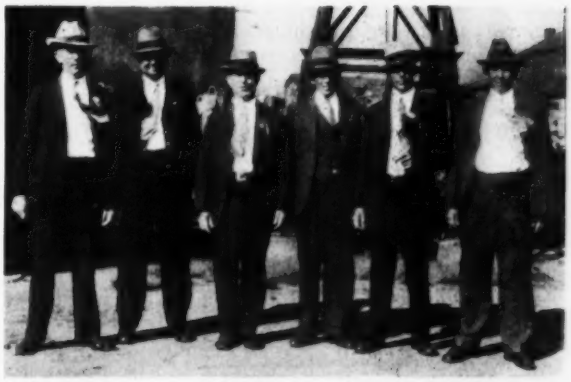
Committee: W. O. Frame, chairman, district engineer maintenance, C. B. & Q., Burlington, Iowa; W. M. Anderson, roadmaster, S. A. L., Birmingham, Ala.; John Clutz, supervisor, Penna., Clayton, Del.; C. H. R. Howe, cost engineer, C. & O., Richmond, Va.; A. A. Johnson, engineer of track, D. L. & W., Hoboken N. J.; W. H. Jones, roadmaster, A. T. & S. F., Chillicothe, Ill.; D. E. Lynch, roadmaster, C. B. & Q., Sheridan, Wyo.; Z. L. Mobley, roadmaster, Sou., Alexandria, Va.; J. R. Perkins, roadmaster, C. R. I. & P., Sibley, Iowa; and W. L. Shanks, supervisor, B. & M., North Adams, Mass.

Discussion

In answer to a question by J. J. Desmond (I. C.) with respect to the employment of machine operators, Mr. Frame stated that in a few cases reported these men were classed as assistant foremen. In other cases they were track men who had been trained by the manufacturers' service men. In no case brought to his attention were the operators' positions bulletined. He also said that in most cases the operators followed the machine from division to division within the limits of the grand division or, on small roads, over the entire property. In many cases these men are provided with outfit cars and in no case of which he has any knowledge are the men paid their expenses. A. Chinn (C. & A.) endorsed the committee's views with respect to the advantage of assigning operators to the same machine during the season, adding that in his opinion the chief advantage of this practice arose from the pride which the men take in their machines, which results in fewer breakdowns.

A. M. Clough (N. Y. C.) outlined the practice of the New York Central Eastern Lines, main-line subdivisions, which differs radically from the general practices outlined by the report. He said that each one of his sections has a tamping outfit, the condition of which is put up strictly to the foreman. Such repairs as cannot be made by the foreman are handled by a mechanic and a helper assigned to the subdivision who are available on call by telephone in the event of trouble. In his opinion the transfer of machines from one division to another would lead to abuse and neglect of the machines.

H. O. Stein (C. B. & Q.) agreed with the committee with respect to the advantages gained by having the operators assist in the repair of the machines during off seasons and inquired whether this practice could not be extended also to helpers, but T. F. Donahoe (B. & O.) raised the question as to whether this practice leads to difficulties with the shop crafts. With respect to this point, Mr. Frame explained that on some roads there are agreements between the shop crafts and the machine operators' organizations which permit of this arrangement. He also favored Mr. Stein's suggestion concerning helpers but explained that on many roads the operating season is so short that it would be difficult to justify the continued employment during the off season of any men other than the machine operators.



Six Representatives of the Big Four

Maurice Donahoe (C. & A.) expressed doubt as to the practicability of keeping operators with the same machines during the entire season, owing to the fact that a given machine is not always operated continuously and in order to keep men employed in the order of seniority he had found it necessary to transfer the operators from one machine to the other. Concerning the training of operators, W. H. Sparks (C. & O.) said that men on his road were trained by manufacturers' service men and that with their help and the supervision given by a motor-car repair man reporting to the division engineer, the service of any special equipment supervisor was deemed unnecessary.

B. E. Haley (A. C. L.) described the practices of the Atlantic Coast Line in the repair of roadway equipment, stating that three repair shops maintained and operated by the maintenance of way department have given much better results than were obtained when the machines were repaired by the motive-power department. Exception, however, is made in the case of the large steam-operated machines which the mechanical department is better organized to handle. In Mr. Haley's opinion primary supervision of the operation and maintenance of the equipment should be provided by the roadmaster who is thoroughly competent to do this if he can be prevailed on to give it attention.

In answer to a question raised by E. Rost (B. & O. C. T.) as to the advantages accruing from the use of power tools, Mr. Frame expressed the opinion that their use is of greater advantage by reason of the improved quality of the work done with them than by reason of the actual saving of labor. J. B. Kelly (Soo Line) disagreed with this view, stating that records kept on his lines showed the actual saving of from 20 to 40 per cent over the performance of the same work by hand labor.

In reply to several questions Mr. Frame stated that on the Burlington the assistant equipment supervisor had a territory of 2,000 to 4,000 miles, depending upon the amount of branch line included, on which, obviously, the amount of power equipment was exceedingly small. The equipment inspectors follow no regular schedule in getting around to inspect the machines but arrange their trips so as to reach the machines that need most frequent attention or those territories upon which difficulty is being experienced. No regular form is used in reporting breakdowns or difficulties with machines.

Elmer T. Howson *(Railway Engineering and Maintenance)* stressed the importance of watching the performance of the machines and their adequate mainte-

nance to insure that they are always in condition for work. The use of machines, he said, will require changes in the methods and organization of the work, while the need for obtaining the maximum service from the machines during as large a part of the year as possible, implies the developments of secondary uses.

In addition to the discussion of these features of the report, considerable time was taken for a discussion of the relative advantages of making ballast raises entirely with the aid of tampers, as compared with making a first lift by hand, to be followed up subsequently by a final machine-made lift.

Division of Work Between Section and Extra Gangs

REPORT OF COMMITTEE

R. L. Sims
Chairman

ONE OF the chief problems of the maintenance officer today is track maintenance. One of the most important problems of track maintenance is the division of work between section and extra gangs, for on it depends to a large extent the amount of work that is done.

Larger engines, heavier equipment and faster speed demand the best possible maintenance in order that traffic may be handled in safety. This committee finds that during the last few years almost every maintenance officer has given considerable study to the reorganing of his forces, as a result of which many roads have increased the mileage of sections, while the average number of men worked each year has not been increased in proportion to the increased mileage on each section. It has been possible to get more work from track forces by reason of more intensive supervision and additional equipment to work with; the use of treated ties and heavier rail have contributed to the same result; these factors, in turn, has made it possible to reduce the number of extra gangs formerly required to do heavy maintenance work.

Importance of Section Work

We find that on most roads the section forces are built up and such forces are allowed as will enable each section foreman to make the tie renewals on all of his track that is not to be surfaced out of face. In order to maintain smooth riding track, section forces are required to level up and line track almost from the time the frost goes out of the ballast in the spring until late in the fall. If such maintenance is not kept up most roads will be troubled with rough track during the winter months.

The section foreman is a very busy man. All the odd jobs are usually given to the section gang. Many roads plan their work each year so that each section foreman shall surface a certain amount of track out of face. If track conditions are favorable, the average number of men allowed on a section during the maintenance season can surface from 1½ to 2 miles of track out of face.

The recent development of labor-saving equipment for use in track maintenance has brought to the front in the minds of maintenance officers the question of rearranging their forces to take advantage of and use such equipment and at the same time avoid prohibitive expenditures.

Some Pertinent Questions

The following questions naturally present themselves for consideration and solution:

1. Can a road afford to supply all its section gangs with such labor-saving equipment as tie tampers, power adzers, bolt tighteners, spike drivers, etc., that at the best can be kept in use only part of the time?
2. Can a road afford *not* to so equip its section gangs with such equipment?
3. Can some of the work generally done by section forces, such as surfacing track, renewing ties, etc., be done to better advantage by an extra gang organized from the force allotment, and supplied with all necessary labor-saving equipment and permitted to concentrate on certain tasks of regular track maintenance?
4. In following a reorganization such as suggested above, how can the total force be distributed so the total man-hours will not be increased?

The last question constitutes the real basis for all studies made, as there is constant pressure on maintenance officers to hold forces to the minimum and to find more economical ways of doing the work.

The first question almost answers itself. It is hardly possible for any road to consider the equipping of all sections with the necessary appliances and it is difficult to set up a practical plan which would allow two or more separate gangs to use the same units.

Answering the first question almost answers the second question, and yet as equipment is developed and becomes more effective and as the labor available becomes less effective and harder to get, the wise use of equipment may be the final solution. Confronted with a situation that makes it necessary to hold the total man-hours to a minimum, knowing that the expenditure involved in equipping all sections as at present organized with labor-saving machinery is prohibitive, and realizing, also, the economies to be realized from the proper use of equipment, the maintenance officer is confronted with a perplexing problem.

Answering the third question as to whether forces can be rearranged and work reassigned, the canvass of a number of roads made by the committee develops the plans of force arrangements in use.

Two Plans for Decreasing Section Work

One road has increased the length of its sections by about 50 per cent without increasing the number of men per section. This has resulted in the release of one-third of the men formerly employed on the sections, and the force thus made available has been organized into what might be termed roadmaster's maintenance gangs of approximately 24 men each, providing two such gangs for each roadmaster's territory. These gangs must not be confused with extra gangs engaged in rail laying or ballasting, but are assigned to out-of-face maintenance work, primarily

surfacing, according to a schedule that covers a portion of each foreman's section each year. The section foreman, thus being relieved of a part of the work on his section, is said to be able to handle satisfactorily a section of greater length without an increase in force. As the roadmaster's maintenance gangs are equipped with power tools, this plan has the advantage of reducing by one-third the number of men whose work is confined to hand labor.

On another road, a somewhat similar plan has been subject to trial which differs from the one described above in that the force organized into a roadmaster's maintenance gang is made available by reducing the forces on the individual sections to a foreman and two men, rather than by increasing the length of the sections. In this case, the gangs range from 70 to

Sections Cannot Be Provided With Machines Like This

100 men each and are fully provided with labor-saving tools. This plan differs from the one previously described, also, in that instead of having the roadmaster's maintenance gang cover part of each foreman's section each year, its work has been scheduled to cover the entire mileage of certain of the sections with an out-of-face program in one year and to work on other sections during the following years. Thus, the gang will be employed on any one section only at intervals of two or three years. This plan is also effective in reducing the proportion of the force that must be confined to hand labor.

The committee cannot make any definite recommendation as to the effectiveness of these or similar plans until they have been subjected to extended trial. The primary question to be raised in considering plans of this kind is whether the reduced section force, particularly where it is limited to a foreman and two men, will be able to maintain track in good riding condition in the intervals of two or three years between out-of-face surfacing by the roadmaster's maintenance gang. The committee seriously doubts whether track can be put up so thoroughly that it will not require spot work in the following year or two in excess of what the restricted section force can handle. However, it is only by development work of this kind that improved methods of organization can be perfected.

Influence of Decreasing Tie Renewals

One question that is definitely involved in this problem of organization is the question of making tie renewals. The effect of timber treatment and adequate protection of ties against wear is becoming manifest on the various railroads. The renewals of ties per mile of track each year are being gradually reduced to a point where considerably less than 150 ties per mile of track are being inserted annually on a considerable number of railroads. Because of the resultant improvement in the average condition of the ties in track and realizing the disadvantage of disturbing track for making renewals, some railway officers are favoring tie renewals on a two-year basis, that is, making renewals at the time of surfacing which insures that no ties will need to be taken out during the following year. On some roads this is even carried further by deferring to the greatest extent renewals in track that is scheduled for surfacing during the following year. With such a plan in effect, there will be a pronounced reduction in the number of tie renewals made by the section forces and, while labor-saving equipment is as yet not a factor in tie renewals, this method should have a pronounced effect on the amount of work to be done by the section forces.

Some railroads have reduced their section forces and increased extra gangs owing to the fact that there is too much interference in the programs of section forces and because of the loss of time to such forces in running long distances when section gangs are doubled up for large jobs. The committee finds that a more effective gang can be organized by using local men where it is possible to get them. A better class of work will be obtained by having each section foreman do as much of the maintenance on his own section as it is possible to get done, because, after all, there is no other foreman so vitally interested in the proper maintenance of a section as its own regular foreman.

Committee: R. L. Sims, chairman, district engineer maintenance of way, C. B. & Q., Galesburg, Ill.; W. J. Daehn, roadmaster, C. & N. W., Sparta, Wis.; G. T. Donahue, assistant division engineer, N. Y. C., Rochester, N. Y.; William Hogan, supervisor, B. & O. C. T., Chicago; C. H. Higgins, roadmaster, Maine Central, Bartlett, N. H.; F. J. Liston, roadmaster, C. P. R., Montreal, Que.; William Shea, assistant engineer maintenance of way, C. M. St. P. & P., Chicago; W. H. Sparks, general inspector of track, C. & O., Russell, Ky.; and D. Wagner, roadmaster, M. C., St. Thomas, Ont.

Discussion

P. J. McAndrews (C. & N. W.) said he is not convinced that it is desirable to substitute extra gangs for section gangs for general maintenance, in view of the demands that are now made on the roadbed by heavy and high-speed traffic. The best condition would obtain where section gangs are maintained of sufficient size to surface a certain percentage of the track each year, depending on the nature of the track, the roadbed, the rail and the demands of traffic. It is not sufficient for an extra gang to go over the track every three or four years, unless it receives considerable attention during the interval. A track gang of 12 men equipped with mechanical tie tampers can surface four miles of track out of face every year, he contended, and still have sufficent time to do the regular maintenance work on the remainder of the section. If necessary, two or more track gangs may be combined to do the surfacing over the two sections with excellent results. Although extra gangs are good for certain kinds of work such as laying rail and ballasting, Mr. McAndrews advocated that the section foreman should not be relieved of responsibility for the proper maintenance of the track.

J. B. Kelly (Soo Line) stated that, while it is desirable to employ large extra gangs to do the out-of-face surfacing, the track must be spot surfaced between visits of the extra gang.

E. T. Howson *(Railway Engineering and Maintenance)* emphasized the fact that we are emerging into a machine age and in the future it will be necessary to utilize mechanical equipment to the greatest possible

extent. It is not possible for section gangs to make the most intensive use of mechanical equipment by reason of the diversity of their duties. A number of roads are now giving this problem considerable thought and intensive efforts are being made to solve it.

Mr. McAndrews explained that it is the practice of the North Western to start its rail laying early in the year, preferably about March 1, in order that it will be finished early in May. As much as possible of the equipment used in this work is then converted into use for surfacing track and is turned over to the section gangs, two of which are consolidated to handle the equipment more easily and to secure better supervision of the work. Tie tampers are the only mechanical equipment that is necessary for section gangs to have in order to do efficient work.

W. H. Sparks (C. & O.) was of the opinion that it is best to have a large extra gang pass over the division and do all of the necessary maintenance work, leaving very little work other than policing to be done by the small track gangs.

C. W. Baldridge (A. T. & S. F.) said that section gangs should be equipped sufficiently to enable them to give the track the proper attention, as, otherwise, it would be necessary for the extra gangs to go over it about twice as often. Section gangs should be equipped with tie tampers and two or more sections should be combined in order to use them properly. Several members concurred in this opinion.

B. E. Haley (A. C. L.) explained that an attempt had been made to combine many of the sections on his road but that the experiment has not been a success. The quality of the work done by section gangs is much better than that done by extra gangs, who strive for quantity rather than quality.

Louis Yager (N. P.) said that the railroads are adopting mass production methods in maintenance work somewhat more slowly than they have been adopted in other industries. In his opinion the problem consists of maintaining the track so that it will meet the demands placed upon it, at the same time reducing the current maintenance cost to a minimum. Although extra gangs do more work per man-hour than section gangs, the latter do a better quality of work and should be maintained. This opinion was shared by J. A. Snyder (M. C.) and R. W. E. Bowler (Penna.).

Laying Rail on the Pennsylvania Railroad

By R. W. E. BOWLER
Division Engineer, Pennsylvania, Pittsburgh, Pa.

R. W. E. Bowler

THE NEED for more efficient methods in rail laying is not peculiar to any one railroad and is developing into a most important problem, largely because of the almost universal tendency to increase the strength of the track structure by increasing the size of the rail section rather than by the use of a more rigid and permanent substructure. Furthermore, within the last two years valuable and interesting studies have been made by a number of railroads which show that our track should be still stronger to carry even our present loads economically. In other words, the situation that exists now is that rail sections which we thought were economical a year or two ago probably are not but, instead, true economy calls for rails from 15 to 40 per cent heavier.

Another important problem which now confronts maintenance of way officers is that the heavier rail sections in 39-ft. lengths cannot be handled safely by hand. No group of men working in unison, as is necessary in handling rails, do so at all times and, regardless of selection or supervision, the danger line is now so close that the American railroads must set about to find a new way to do the job. The solution resolves itself into rail laying by mechanical means, but the selection of the most satisfactory and economic mechanical way is the problem which we railroad men will have to work out.

Mechanical rail laying on the Pennsylvania has been in progress in various stages since 1927. Certain semi-mechanical devices for setting rails in and out of track have been in use considerably longer but the success with which they were used could not be considered marked nor adequate. During the last three years, however, reasonably good results have been obtained by several methods varying slightly in detail on account of operating conditions and the kinds of equipment available.

We will not attempt to go into the merits of all of the various practices developed to date but will only consider one which has worked out reasonably well and which has substantially reduced handling costs as well as personal injuries in the ranks. The division on which this method was developed and used does not consider it adequate nor does it presume to go on record as having the best practices in mechanical rail laying. The object of this paper is to improve our practices generally by an exchange of ideas as well as by constructive criticism which the Pennsylvania most certainly welcomes.

Complete Occupancy of One Track

On a multiple-track railroad, even with heavy traffic, it has been proved conclusively that, under normal conditions, a main-line track can be given up for eight-hour periods without serious interference with traffic and, with such an arrangement, new rail should be distributed and applied and all old rail and fastenings loaded in the course of one occupancy of a track. This reduces, by 50 per cent the time the track has to be given up over the old method of using it at three different intervals. Furthermore, by this method, one good mechanical unit can carry on satisfactorily over an entire superintendent's territory during the rail-renewal season, rather than have each supervisor break the track to lay his own rail, which means the use of track simultaneously at several places instead of one. This means a decided saving in operating costs which is not reflected in any figure given in this paper.

In order to complete the operation at one time the rail-laying train must be equipped with two locomotives, one to be used with the first unit to distribute

the new rail and fastenings, the other to pick up the old rail and all of the unapplied materials removed from the track. Each of these units is equipped with an eight-ton caterpillar gasoline crane designed to crawl through the ordinary type of drop-end gondolas in the rail-unloading and loading operations. It will be of interest to explain here that a locomotive crane was used in the place of the second locomotive at first but, because of the necessity of shifting after two cars were loaded and the fact that it was badly balanced with the rest of the unit, it was found necessary to put on the second locomotive to keep up with the procession.

The Method

In addition to the unloading of new rail, the first unit distributes, at the proper place, all the splices, bolts, spikes and other fastenings, care being exercised to unload just as much material as is needed and no more. second locomotive with empty drop-end gondola cars to pick up the old rail and all fastenings and scrap taken out of track. The matter of cleaning up after the rail laying operation is most important so that there will be no subsequent work-train service after the track is given up.

In this brief description we have given the order of the various larger mechanical units used but have not given the man power necessary because of the possibility of confusion. However, the accompanying chart shows the entire organization with the function of each machine and the men, by groups, and explains the operation more in detail.

Costs Have Been Reduced

This method, which we feel should be improved upon in 1931 has, however, reduced our rail-laying costs very substantially since it has been in use, and

ORGANIZATION FOR A RAIL-LAYING UNIT—PENNSYLVANIA RAILROAD

	Sub Unit	Machine	Men
General Foreman			
	1 Unloading rail and other track material	8-Ton gasoline Caterpillar Crane	1 Work-equipment engineer 3 Men on car handling rail 3 Men on ground handling rail 2 Men unloading splices 2 Men unloading small track material
Foreman	2 Pulling joint spikes and raising inside spikes		8 Men pulling joint spikes with claw bars 4 Men raising inside spikes with claw bars
Asst. Foreman	3 Pulling spikes with spike pullers 4 Removing nuts from bolts on old rail	Compressor	1 Machine operator 8 Men using four spike pullers 1 Welder cutting frozen bolts 4 Men using two nutters
Foreman	5 Lining out old rail		2 Men with lining bars 1 Man used as watchman for groups 2 to 5, inclusive
	6 Setting out old rail Setting in new rail	15-Ton locomotive crane	1 Work-equipment engineer 1 Man handling rail tongs 2 Men steadying rail, one of whom places shim 1 Man with claw bar to pull foul spikes 2 Men with lining bars to line rail in place 2 Men applying holding spikes
Asst. Foreman	7 Applying splices		2 Men using splice clamp 4 Men applying splices and first two bolts 2 Men with claw bars pulling spikes at joints 4 Men applying bolts by hand
	8 Setting spikes		2 Men
	9 Tightening nuts 10 Driving spikes	Compressor	1 Machine operator 4 Men using two nutters 2 Men with wrenches giving final tightening 4 Men using spike drivers
Foreman	11 Applying rail anchors		2 Men
	12 Picking up old rail and other track material	8-Ton gasoline Caterpillar Crane	1 Work-equipment engineer 3 Men on ground handling rail 3 Men on car handling rail 2 Men loading splices 2 Men loading small track material 1 Man used as watchman for groups 6 to 11, inclusive

Summary of Organization

1 General foreman
2 Foremen
2 Assistant foremen
3 Work-equipment engineers
2 Machine operators
1 Oxwelder
82 Trackmen

93 Men—Total

Safety Precautions

Train crews protect units 1 and 12.
Two men assigned exclusively to warn units 2 to 11, inclusive, of trains moving on adjacent tracks.
All warning signals are given by whistle.
All rail cars are side staked on side where there is no speed restriction on the adjacent track.
Whenever adjacent track is fouled, it is protected by Rule 101—Book of Rules.

Following this unit is a self-propelled compressor with two spike pullers and two nut turners to uncouple the rail to be taken out. Some hand work must precede this to remove joint spikes, with a torch to cut out frozen bolts that cannot be removed by the pneumatic machines so that the third unit, which is a 15-ton locomotive gasoline crane, can move through without interruption. This crane sets the old rail out, both in one intertrack space, and sets the new rail in track. Following this unit is another self-propelled compressor with two spike drivers and two nut turners to secure the new rail properly in place. Following this is the has improved our safety record as well. Hand laying by the old method costs, in many cases, around $5 per ton. This cost has been constantly coming down as we have improved our mechanical efficiency, a good average for rail laying during 1930, to date, being about $2.75 per ton. In one case where the conditions were ideal, the rail was distributed, laid, and the old material all picked up for $1.42 per ton. All charges for engine supplies and expenses, labor costs, as well as interest and depreciation on equipment are included in the above figures. This day's work for the unit embraced the laying of 619 39-ft. 130-lb. rails in eight hours.

Your problem and mine is to develop a better and cheaper method so that the matter of replacing rails under all conditions will be no more of a task than any of the various other phases of ordinary track maintenance. We should not feel that any practices which we have in use are good enough until our managements figure out something better. It is not their job but yours and mine because we should be better able to work out such details and pass them along for approval.

One possible solution that I have in mind is that one machine can and should be designed to take the place of almost all of the units now in use, one that will permit the free and uninterrupted use of all tracks except the one occupied, that will, by means of carriers, place the old rails and fastenings in cars and set the new rail in place, with the necessary compressors and magnets to fully handle the entire operation. Such a device will require careful study of all the conditions to be met on a multiple-track railroad and will not be accomplished in a short time. But when it is, rail laying will not present the hazards or difficulties now involved.

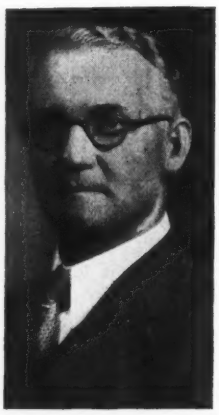
This may not be exactly the answer. Some of you may have a better solution because, after all, the man with the practical mind for doing things in the field as you all are trained to do, will be expected to give to our managements the real answer. Rail laying today is costing the railroads more than it should, actually, as well as in compensation for injuries. The latter, which every railroad management sincerely regrets, is reflected back into the ranks in loss of wages and consequent suffering to their families.

Discussion

The discussion of Mr. Bowler's paper consisted of questions by various members to bring out more clearly the details of the practices which were described in his paper. No discussion took place as to the adaptability of this or other methods of laying rail on other roads.

Recent Developments in Roadbed Drainage

REPORT OF COMMITTEE



J. A. Snyder
Chairman

THE drainage of railway tracks is a subject that has received attention from engineering and maintenance men since railway building and maintenance began. It has been discussed formally and informally wherever these men have assembled and all are agreed that it is one of the most important, if not the most important, subject in relation to railroad track.

You are familiar with the old story of a chief engineer who was asked what the most important engineering problem in railroad construction was and whose answer was "drainage." The questioner then asked what was the next important problem to contend with and his answer to this was "more drainage."

The dictionary defines drainage as a system of drains and their operation as one for removing superfluous water from fields, towns, railroad beds, mines, etc.

The development of the theoretically correct drainage system for any project requires consideration of rainfall, topography, runoff, soil, etc. A knowledge of rainfall, its intensity, occurrence and distribution is necessary in designing a drainage system of any kind. The amount of drainage trouble on any railroad depends very largely on the amount of rainfall, the topography and the kind of soil of the country through which that railroad runs. Runoff is that portion of the rainfall which passes over or through the ground to a drainage system; whether this runoff passes over or through the ground depends on the character of the soil.

The character of the soil is expressed in terms of texture and structure. Texture refers to the range of sizes of individual particles, while structure refers to the arrangement of these particles. Texture and structure determine the resistance to the flow and the slope of the surface of the ground water. The finer the soil, the smaller will be the pore spaces or channels through which the water moves and the higher will be the resistance to flow. In other words, the rate of percolation varies directly with the size of the soil particles until in some soils the pores become so small as to be completely filled with capillary moisture. In loam and sand the channels are comparatively large and the flow fairly rapid. In dense clay the pores are usually completely filled with capillary moisture and the flow is very slow.

The presence of large quantities of water in soil tends to break down its structure and to make it pliable under pressure. Thus, water in a railway roadbed tends to make it soft and easily moved under traffic, and increasing loads and greater speed tend to cause the roadbed to settle directly under the track structure, this settlement forming a trench which collects and holds the water just where every track man knows it should not be.

The roadbed of the early railways was made by scraping the hills into the valleys. The cuts were narrow and the fills were still narrower. Very little consideration was given to drainage, except possibly to provide some side ditches in clay cuts and culverts or other openings at stream crossings. Little if any ballast other than the local soil was required as the equipment was light and the speed slow. With the increase in weight of the equipment and loading and the increase in speed of all classes of trains, the old time track structure was not sufficient. Heavier rail and ties and more substantial ballast were necessary and, in order to maintain this modern track structure on the same subgrade, it became necessary to keep as much water as possible away from it. To provide a wider and more stable roadbed, the cuts and fills have been widened and side ditches dug.

Water Pockets

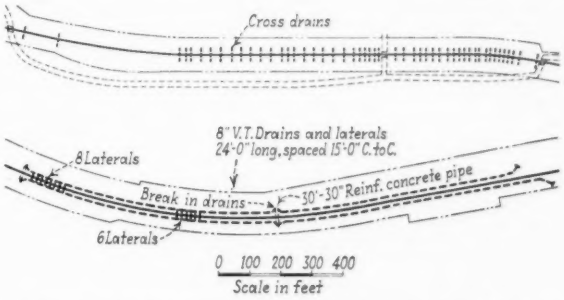
On account of the heavier loads and higher speeds of trains, there has been considerable trouble in clay or quicksand soil with water pockets which cause the embankments to settle and slide, throwing the track out of line and surface and necessitating slow

orders. Also in parts of the country where severe cold weather prevails for months in the winter season, the tracks heave and shims are necessary to maintain even fair surface.

In general, drainage problems on railroads in different parts of the country are similar and the same solutions will usually apply, although there may be some cases which require special treatment. Following are brief descriptions of several solutions of drainage problems which were received by the committee in response to a short questionnaire:

Drainage of Single Tracks

In September, 1925, the Ohio Central Line of the New York Central drained two cuts on the Hobson-Meigs cutoff by laying 8-in. vitrified sewer pipe about 5½ ft. below the rail on each side of a single main track with laterals extending under the roadbed at



Examples of the Use of Cross and Longitudinal Drains

intervals of 20 ft. These two projects included the laying of 7,897 lin. ft. of 8-in. vitrified sewer pipe at a cost of 28 cents, $2,205; a total of 1,000 cu. yd. of common dry excavation removed to an average depth of 3½ ft. at 90 cents, $900; 719 cu. yd. of common wet excavation of an average depth of 3½ ft. at 90 cents, $647; 669 cu. yd. of cinder backfill at 80 cents, $532; excavating and backfilling ballast, $224; total cost of both projects, $4,508.

Also, in August, 1926, this railroad drained two other cuts on the same line by laying eight-inch vitrified sewer pipe about 4½ ft. deep on each side of a single main track with laterals 24 ft. long at intervals of 15 ft. These two projects included the laying of 6,528 lin. ft. of 8-in. vitrified sewer pipe at 22½ cents, $1,469; 400 cu. yd. of common wet excavation and 862 cu. yd. of common dry excavation at $1.033, $1,304; and 1,700 cu. yd. of cinder backfill at 60 cents, $1,015; total cost of project, $3,814.

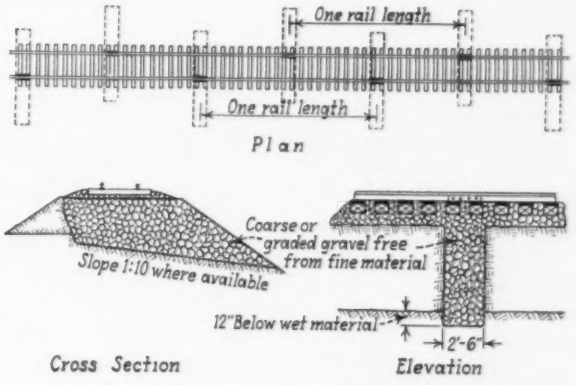
One division of the Chicago & North Western reports that all cuts have been drained by laying six-inch tile on each side of the track. Before these drains were laid it is stated that it was impossible to keep the track in good surface during wet weather in the summer, or when it heaved in the winter. Slow orders were frequently necessary. Since these drains were laid, the conditions have improved, the track is kept in good surface and slow orders are not necessary. The cost of doing this work was approximately six cents per foot for six-inch tile and from $1 to $2.50 per rod for labor, the latter figure for laying the tile in quicksand.

On one division of the Missouri Pacific, considerable trouble was caused by soft material in fills forming water pockets during heavy rains. In some places as much as five or six feet of settlement resulted. These conditions were overcome by the construction of cross drains as follows: A trench about 2½ ft. wide was dug at each rail joint to a depth of about 12 in. below the bottom of the wet material, extending from the ballast line on the opposite side to the side of the fill, on a grade of about 1 to 10 and this trench filled with coarse gravel free from fine material. These drains were staggered the same as the rail joints. The labor cost of this work ranged from $5 to $8 per drain, while the cost of material was only the transportation as it was taken from gravel pits on the line.

Also, at some points on the Atchison, Topeka & Santa Fe similar cross drains were constructed with satisfactory results.

In 1923, 1924 and 1925, a 50-mile single-track division of the Michigan Central between Detroit and Toledo was ballasted with 12 in. of crushed rock. Most of the old ballast was cinders with several short stretches of crushed rock. The roadbed was narrow and poorly drained. The cuts were not wide enough for adequate side ditches and the embankments were so narrow that ballast shoulders could not be maintained; center bound track in the summer and heaving track in the winter were the result.

Before the ballast work of each year was started, the roadbed was prepared by using a steam shovel ditcher, steel side dump cars and a spreader. All cuts were widened as far as the ditcher could reach from the main track and deep enough to provide good side ditches. The excavated material was placed on the embankment and leveled to a uniform standard section wide enough to retain the ballast. This work was completed in 1925 and since that time very little



Drainage Method Employed on the Missouri Pacific

hand ditching has been necessary and practically no shims have been used.

One short cut about 400 ft. long caused considerable trouble on account of the roadbed sliding into the side ditch on the inside of a curve, throwing the track out of line and surface. It was necessary for the section men to work on this curve every week to keep it suitable for the usual speed. Sewer tile was laid in this ditch with laterals extending under the track and the trenches filled with ballast rock, since which time very little additional maintenance has been necessary.

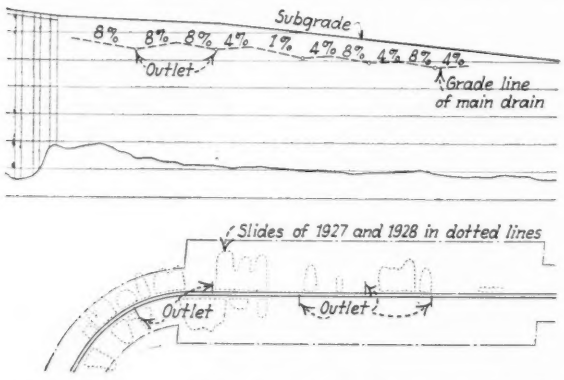
Drainage of Multiple Tracks

With the construction of multiple main tracks, drainage troubles have increased as the side ditches in cuts do not take care of the drainage of interior tracks adequately without under drains of some kind. In side-hill cuts trouble is often experienced on

account of springs which keep the cuts wet, while in the winter the roadbed along the ditches carrying the spring water does not freeze like the opposite side and uneven track is the result, making the use of shims necessary.

A rather difficult multiple-track drainage problem was reported by the Atchison, Topeka & Santa Fe. The two main tracks of this railroad cross the Missouri river on a high bridge at Sibley, Mo., about 25 miles east of Kansas City. East of the bridge the tracks lie on the north side of the river and cross the valley on a high hill to the bluffs opposite on a 0.5 per cent grade descending from the east end of the bridge. The fill at the bridge is about 52 ft. high. It was made of sandy clay which was hauled in by work trains. The tracks were ballasted with gravel. When the ballast and embankment became saturated with water, pockets developed from 6 to 12 ft. below the rail, which resulted in slides serious enough to put the tracks out of service. There were about 20 of these slides within a distance of about 5,000 ft.

After considerable study of the problem, it was thought that the best results would be obtained by installing a drainage system that would collect and carry off the surface water before it would fill the pockets and saturate the embankment. The plan finally decided upon was to dig a trench about 2½ ft. wide between the tracks, which are on 14-ft. centers, and as deep as the pockets—about 8 ft. below subgrade. In this trench was laid six-inch perforated corrugated pipe on grades varying from 0.4 per cent to 1 per cent and the trench was then filled with crushed rock. At intervals of 50 ft., lateral trenches 13 ft. long were dug at right angles to the main drain and 8-ft. lengths of the same kind of pipe were laid on an 18 per cent grade; these also were filled with



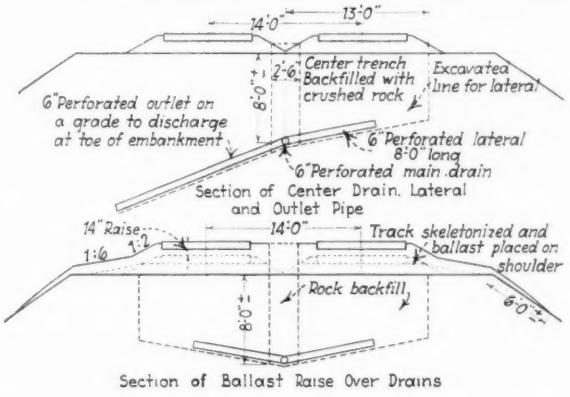
Map and Profile of the East Approach to the Missouri River Bridge at Sibley, Showing the Location of Slides

crushed rock. At intervals of 500 ft. discharge pipes were laid from the main drain to the natural ground at the foot of the slope, the ends of which were protected by headwalls of concrete. All these pipes were laid on a bed of from four to six inches of crushed rock. The main drain is about 3,500 ft. long.

As further insurance against filtration of water into the ballast pockets, a 12-in. raise of grade was made on limestone screenings and a blanket of the same material was extended about 12 ft. down the slopes on the outside of the pocket. The cost of this work was approximately $11 per lin. ft. of track. The work was completed in 1929 and to date has shown no indication of failure.

On three or four-track roads, drainage is usually provided by under drains and catch basins to remove the water to the side ditches. One division of a four-track line advises that the two interior or high-speed tracks are maintained from four to six inches higher than the outside or low-speed tracks, which with rock ballast facilitates the natural runoff of the water and no difficulty is experienced. At railroad crossings and track tanks, boiler flues or other pipe drains are laid.

Another road reports that: "It has been standard



How the Santa Fe Met the Drainage Problem at Sibley by Using Perforated Pipe

practice on our four-track lines to drain all cuts thoroughly, using vitrified tile or perforated iron pipes of sizes large enough to carry the water. These are placed in the outside drains at a depth required by the local conditions. Frequently in very wet cuts where springs are in evidence, short sections of pipe are laid between the tracks and connected with the side ditches. During the time of gravel ballast, catch basins and drain boxes were installed at regular intervals in both cuts and on fills to carry surface water quickly to the outside ditches, but since the use of stone ballast it has not been necessary to maintain cross drains."

Yard Tracks

This committee is of the opinion that, in general, the drainage needs of both main tracks and yards are apparent and that details of installations already made are worth considering in this report. We present, therefore, brief descriptions of a few systems that have been installed within the last few years. They represent a variety of conditions and the same methods may be readily adapted to other locations and conditions.

About 15 years ago, on account of grade separation, a double-track industrial belt line was depressed about 13 ft. and laid on a one-per cent grade. On one side of this cut there was a slide about 800 ft. long which caused considerable trouble. About twice each year it was necessary to use a work train and section men to clean this cut and dig new side ditches. After some years of this, the cut was drained by laying vitrified sewer pipe on one side for about 800 ft., with two catch basins, since which time there has been no necessity for any extra work to keep this cut in good condition.

In the early part of 1925, a receiving yard was enlarged by laying 13 additional tracks between the two main tracks and the existing receiving yard of 12 tracks. In order to utilize all of the available space, the 13 new tracks were laid in two groups of

7 and 6, with a ladder lead at each end of each group. Extending across the existing yard and the main tracks at approximately right angles were iron pipe culverts with an open ditch between them. In this ditch was laid iron and concrete pipe and into this pipe was tapped the drainage system of the switches of the new tracks and several of the old. Between the two groups of the new tracks, a 12-in. vitrified sewer pipe was laid, with a catch basin at each switch. These catch basins were made by setting 12-in. crosses or double tees at grade and extending up to within a few inches below the ballast, with a cast iron grate in the bell of the pipe. The drainage during wet weather has been well taken care of and during freezing and thawing weather in the early spring, there is no difficulty on account of frozen switches and no section men are required at night to keep the switches operative. In this system, there are 22 catch basins and about 2,200 ft. of sewer pipe.

During the reconstruction of the local freight and produce terminal yard of the Michigan Central at Third and Twelfth streets, Detroit, in 1925, a rather complete drainage system was designed and installed. This yard varies from 400 to 500 ft. in width and is approximately 3,900 ft. long. It lies parallel to the Detroit river and the general elevation is between four and five feet above the river level. About four miles of the tracks in this yard are team tracks and the balance house tracks, leads, storage tracks, etc.

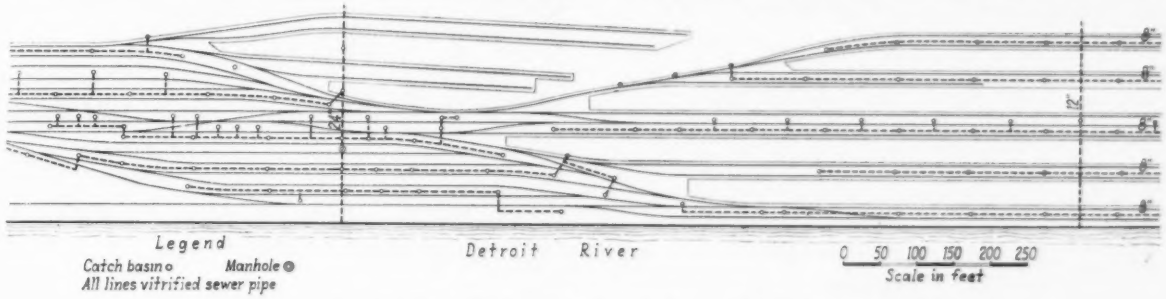
A five-foot double-barrel city sewer crosses the yard about 800 ft. from the west end at an elevation so high that the system is divided into two unequal parts. Between each pair of team tracks and between alternate storage tracks, 8-in. vitrified sewer pipe was laid with catch basins spaced about 100 ft. apart. These 8-in. sewers were intercepted by 12-in. sewers crossing the yard and flowing directly into the river. Extra catch basins were put in to serve switches, double slips, etc. In all, there were 300 catch basins, 63 at switches and 237 between the tracks. Owing to the fact that this area was made available by filling the river out to the established harbor line, the cost of laying this sewer pipe was rather high, although no cost figures were obtained.

Catch Basins at Switches

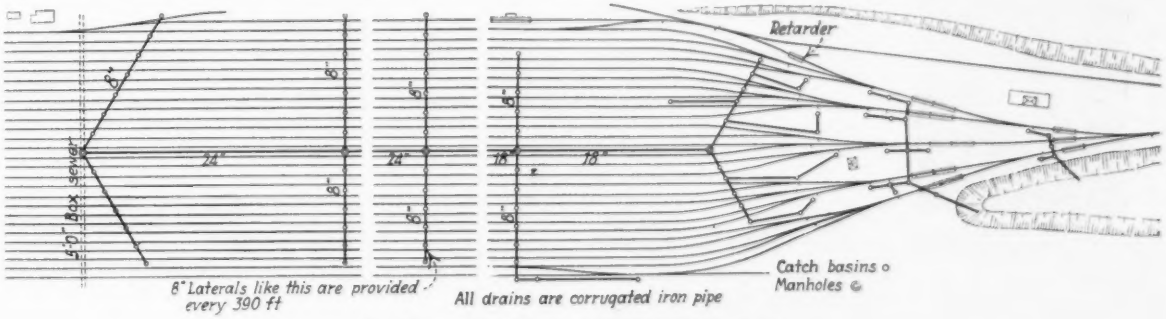
During the latter part of 1929, a very important interlocking plant was entirely reconstructed at the point where the double-track Toledo division of the Michigan Central leaves the four-track main line at West Detroit. While this was being done, the tracks also were reconstructed, using lighter curvature, longer crossovers, slip swtiches, etc. The layout included six simple turnouts, three crossovers, one single-slip switch and eight double-slip switches, all using No. 10 frogs.

The drainage system was also rearranged. Vitrified sewer pipe and iron pipe of various sizes was laid below frost line between and under the tracks and the entire system was tapped into a city sewer. Each switch was provided with at least one catch basin and the slip switches were provided with three. Where two slips were placed directly opposite each other, three catch basins between them take care of both slips. These catch basins were made by setting 12-in. sewer pipe crosses or double tees to grade and extending them up to within a few inches of the ballast and placing cast iron or steel grates in the bell end of the upper section of the pipe. This system includes about 60 catch basins. It has been very satisfactory and the plant and tracks are dry at all times.

Last year the westbound classification yard, consisting of 31 tracks of the Michigan Central at Detroit, was equipped with electrically-operated car retarders, and it was necessary to redesign the switch layout of the entire yard at the hump end. In connection therewith, quite an extensive drainage system was designed and constructed. Between Tracks 17 and 18, corrugated perforated iron pipe about 2,300



A Part of the Drainage System in the Detroit Yard



Drainage System for a Classification Yard

ft. long was laid with 7 brick manholes spaced 390 ft. apart. This pipe drains into a 5-ft. concrete box culvert which crosses the yard about 3,300 ft. west of the hump. The westerly 1,170 ft. of this pipe is 24 in. in diameter and the balance is 18 in. From each of the manholes, laterals of eight-inch corrugated pipe were laid in both directions across the yard, with special iron catch basins located in alternate track spaces. The catch basins are iron-pipe double tees, extending up to within a few inches of the ballast between the tracks. In this system there are 90 catch basins to drain the tracks and 29 to take care of retarders and switches.

Committee: J. A. Snyder, chairman, division engineer, M. C., Detroit, Mich.; O. Anderson, district roadmaster, L. A. & S. L., Los Angeles, Cal.; A. B. Chaney, division engineer, M. P., McGehee, Ark.; C. A. Geiger, supervisor of track, N. Y. C., Toledo, Ohio; H. H. Hann, roadmaster, N. Y. O. & W., Walton, N. Y.; P. J. Hurlihe, track supervisor, N. Y. N. H. & H., Danbury, Conn.; C. M. Hayes, assistant general roadmaster, M. St. P. & S. S. M., Minneapolis, Minn.; A. L. Kleine, roadmaster, A. T. & S. F., Marceline, Mo.; C. T. Kimbrough, general roadmaster, I. H. B., Calumet City, Ill.; and Charles Kratoska, roadmaster, C. & N. W., Ames, Iowa.

Discussion

The discussion on this report brought out the fact that sometimes it is impracticable to tile both sides of a cut on single track, in which case tile on one side only of the cut often gives satisfactory results. In cases where soft material is encountered, placing a board in the bottom of the trench will avoid distortion of the line or surface of the tile and permit it to function properly over long periods.

The general concensus of opinion was that trenches for tile drains in cuts should never be backfilled with the excavated material, but the back fill should be made with locomotive cinders or other porous material. P. J. McAndrews (C. & N. W.) said that his road had laid considerable drain tile between tracks on double-track lines, particularly through station grounds. In the latter locations catch basins are installed at all street crossings and at switches and frogs. These installations have invariably given satisfactory results.

J. B. Martin (N. Y. C.) recommended the use of perforated metal pipe, with the perforations down, in soil that shows a tendency to flow sufficiently to disturb the line or grade of the drainage tile.

The question was raised as to whether the bell of vitrified sewer pipe has sufficient strength to carry the grating which is used to cover the manhole openings in yards and elsewhere. Several roadmasters replied from their own experience that there was no question but that the sewer pipe had sufficient strength for this purpose.

European Track Maintenance and Construction

By J. V. NEUBERT

Chief Engineer Maintenance of Way, New York Central, New York

J. V. Neubert

DURING my recent visit to Europe to attend the International Railway Congress at Madrid, Spain, I traveled through France, Spain, Italy, Switzerland, Germany, Belgium and England, covering 6,000 miles, the major part of my journey being by rail. In this trip I found that the equipment used in Europe does not compare with that used in America. The maximum average axle load of the locomotives is about 17 tons, although this is now being increased in some countries to approximately 22 tons. The passenger coaches, which are classified as first, second and third class, with the first class somewhat similar to our Pullman cars, are much lighter and considerably shorter than the cars used for similar service in this country. The majority of them have a single axle at each end, although a few of the third-class coaches have three axles, one at each end and one in the middle. These coaches carry 18 to 30 people.

The speed of certain of the European passenger trains is much higher than here. As a whole, however, the speeds are not comparable to those in America, considering our longer trains and greater tonnage.

The freight equipment is unusually light, the cars having a single-axle truck on each end similar to those on the passenger coaches. In a few of the countries, particularly Switzerland and Germany, the railways are beginning to use the four-wheel truck, with longer cars capable of carrying heavier loads. The average weight per freight car is approximately 15 tons, and I doubt if the maximum will exceed 20 tons. In fact, one can get a very good idea of the weight of these cars from the fact that turntables are used for turning them for platform or team-yard loading and unloading in many of their yards and terminals, and two men easily turn the table by hand, with the cars either loaded or empty. The freight runs are short and the nature of the commodities is such that there is no brine to cause corrosion.

The speed of freight trains averages much less than in America, the maximum not exceeding 20 m.p.h. with much lighter train loads. In some countries, particularly in France and Spain, they still rely on the hand brake for stopping and controlling the train.

Right of Way and Roadbed

The right-of-way fencing in Europe is not of any special or standard design. In the majority of the countries, they use reclaimed ties or similar material, whole or sawed up into posts or boards for fences. The majority of the fences are of the tight-board type, and, where rock is obtainable, they use tight slab stone fences in many cases.

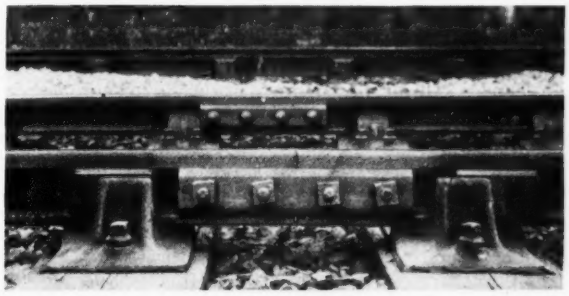
Great pains are taken to provide station layouts and they have very elaborate floral beds and shrubbery; but in general, the right of way outside of these locations, is not as orderly as in America, except in England where the appearance of the right of way is on a par with and possibly excels that in America.

The roadbed abroad seems to be well laid and is prepared prior to the installation of the track. In many of the countries this is done by rolling. The effect of this practice in the prompt establishment of time-card or schedule speeds is very noticeable when new lines are placed in service.

Until about 1910, the heaviest rail averaged 75 to 80 lb. per yard, but the prevailing weight now in use in

these countries is of 85 to 100-lb. section. About 1910 the railways of Europe started to modify their rail specifications so as to require open-hearth steel instead of Bessemer, as was done in the United States, and their specifications are now similar to those used in this country.

Practically all of the rail in these countries is of the T-section, except in England, where the rail is of the bullhead type. However, in the last year or two, some of the English roads have put in small test sections of



The English Bullhead Rail Supported on Chairs and Secured by Wooden Wedges—Note the Fish-Plate Joints

T-rail for experimental purposes. The original idea in using bullhead rail was to obtain double service by reversing the rail but I have been informed that this has not been the practice for the last 25 years.

The rails average about 45 ft. to 49 ft. in length, except in Germany where they are installing both 15 and 30-meter lengths, approximately 50 ft. and 100 ft. long, at present.

As a rule, the rail in European countries is laid with some expansion allowance. The joint fastenings are angle bars, fish bars or other similar devices, held in place with standard bolts, usually spring washers or net locks are used similar to those in America. The length of the bars varies from 19 in. to 26 in., and the various designs used throughout Europe are the most complex I have ever seen. The joints are laid opposite, the reason for this being that, as renewals and replacements are made, both rails and ties can be taken out as a unit and the roadbed replaced out of face with no half-rails projecting on each end of the section of track removed. Furthermore, it is believed that opposite joints give a more nearly perfect riding condition.

Crossties

The prevailing crossties used are wood, similar to our yellow pine, oak and other hardwoods, such as beech, birch and maple. However, in Germany and Switzerland many steel ties are used, and this is true to some extent in Belgium, England, France and Italy. There are very few automatic signals in Europe, so the installation of steel ties is not influenced by the necessity of considering track circuits. France seems to be developing the use of concrete ties, of which large numbers are in service. Other countries use them to a very small extent and, generally, for experimental purposes only.

The prevailing method of treating wood ties is to inject creosote or a mixture of creosote and coal tar. Other treatments are used, however, but they have been employed more in the nature of tests for development and experimentation, than in routine practice. The ties average from 4½ in. to 5 in. thick, 9 in. to 11 in. wide on the face, and 8 ft. to 8 ft. 6 in. long. In Germany they use ties which are 6 in. by 9 in. by 8 ft. 6 in. long.

The railroads of Europe seem to be a unit in favoring a very secure and rigid fastening of the rail to the tie, so that the tie, tie plate, and rail, act as one unit. For example, in France, the rail is fastened to the tie plate and tie with one screw spike on the outside and two screw spikes on the inside, this method of spiking being reversed on alternate ties. This method of spiking is also practised where they do not use tie plates but use instead a light compressed wooden shim under the rail, and in their concrete tie construction where the rail rests directly on the tie.

In Spain, the rigid fastening is usually made with bolts and clips, but in some instances this is done with one screw spike and a clip on both the inside and outside and in other cases with one spike on the inside and two on the outside or shoulder side. In some sidings they use plates with cut spikes but this is rare enough to be unusual.

In Italy the rail fastening is very heavy, consisting of a bolted clip on top of the shoulder tie plate. In some cases, the tie plate is fastened to the tie by screw spikes, and the rail to the plate by independent bolts and clips. In many cases, there is one clip on the shoulder or outside and two bolted clips on the inside.

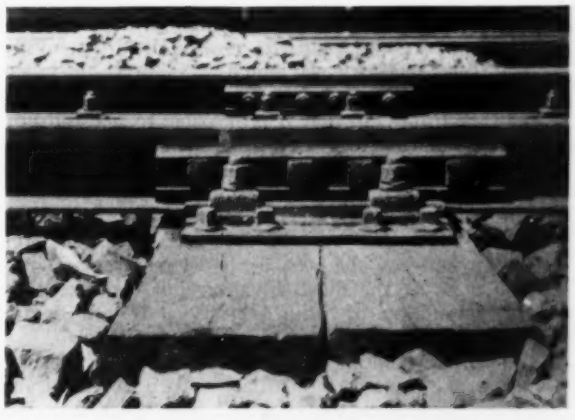
In Switzerland the fastening to the wooden as well as to the steel ties is with a bolt and clip, in general, one bolt and clip on the inside and one on the outside. At a few locations, particularly on heavy curves in the mountain territory, they have two bolts and clips on the outside at every tie.

In Germany, the usual method of construction has been to fasten the plate to the tie and rail by means of a screw spike, similar to the Abbott shoulder fastening, using an independent screw spike on the shoulder side. Some of the railroads, prior to the time when the three large systems were consolidated into one, had been using a construction similar to that in the other countries. The present standard, known as the G E O track construction, has four screw spikes to each tie plate for fastening the plate to the tie. The rail rests between double shoulders and is fastened to the plate with bolts and clips. The fastening on the steel ties is similar to that on the wooden tie.

In Belgium the construction is similar to the shoulder design employed in Germany. In some cases, however, they use the French method of compressed wooden shims with a screw-spike fastening.

In England the rail rests in chairs, which are large castings, and is secured with either wooden or steel spring wedges. The chairs are fastened to the tie, generally with one screw spike on the outside and two on the inside.

The gage of the track in all these countries is about



A German Rail Joint of the G E O Type—Note the Use of Heavy Double Ties Under the Joint

4 ft. 8½ in., except in Spain where the gage is 5 ft. 3 in. The gage seems to be well maintained in all of these countries; in fact, it should be because of the heavy fastenings that hold the rail to the tie plate and the tie plate to the ties.

Ballast

In general, the ballast is crushed stone, but it is not nearly as uniform or regular in size as that used in America. In fact, very little time or consideration is given to the proper size of the stone. The countries that use stone ballast as standard are England, Switzerland, the northern part of Italy and a little more than half of Germany. Elsewhere, the ballast is gravel or other satisfactory material. In Europe the sidetracks are ballasted with the same material as the main tracks. For example, in territory where stone ballast is used on the main tracks, all the yards and connecting tracks

A Form of Composite Tie of Steel and Concrete Now Being Used on Railways in France

are ballasted with stone. If the main track is ballasted with gravel or cinders, the sidetracks are ballasted with the same material.

General Maintenance

From my observation, the general maintenance program is quite different from that in America. For example, an estimate is made of the average life of the entire track structure, and the life of the rail is based on this average. A schedule is then set up as to the amount of rail to be renewed and the entire track structure, rail, ties and fastenings, is taken up, the roadbed smoothed down and new material put in its place. The mileage set up for renewal depends upon the new rail schedule and the general condition of the track in the territory on which it is to be installed. While this work is being performed traffic is detoured over other tracks, so that it is possible to get full-time use of the track while they are replacing the roadbed and track. Most of the railroads in Europe consist of two or more main tracks, and this makes it possible to detour trains to facilitate the maintenance work. In detouring trains for work of this character, a schedule is set up between the various departments, so that it can be done at the most advantageous time with the least interruption of train service, and with greater economy.

When a new line is built in Germany the roadbed is rolled as it is constructed, ballast is then unloaded and, after it is spread on the subgrade, it is rolled to a hard surface before the ties are placed and the track constructed. Next, loose stone is applied, sufficient for a slight surfacing lift and the necessary filling and dressing. When the track is put into service on the new roadbed, it is possible to operate at schedule speed within a very short time, a maximum of two days, I was told.

When track is replaced out of face in this manner, it rides smoothly, as one might expect. But the work is not followed up with periodic programs of general surfacing as is generally done in America. With the lighter axle loads and lighter total tonnage, this possibly may not be required as it is here. In general, through Europe, surfacing is spot surfacing. When surfacing on the French railroads, particularly in stone ballast, which is very coarse, the coarse ballast is moved to one side and ½-in. or ¾-in. stone, which is held in reserve in ballast bins along the right of way, is used to tamp up the irregular spots, after which the coarse ballast is replaced.

In all of these countries, great stress seems to be placed upon the alinement of curves. Trains are generally operated over curves at somewhat higher speeds than in America, and, in my estimation, with greater ease and comfort. I believe that this is due entirely to the fact that an established uniform grade is required, that is, no sags are permitted throughout the length of any curves, and for distances on the tangents. This requirement, together with the uniform alinement, certainly produces smooth riding curves.

Turnouts

Turnouts, switches and slips are completely assembled along the track or at some point on the right of way, not only in congested yards but also at outlying points, and then slid into place. Practically all of the frogs are rigid and of bolted construction. The prevailing turnouts are for No. 9 and No. 10 frogs. Double-pointed frogs are used almost universally in both single and double slips. As a whole, the turnouts ride very roughly. In fact, little attention seems to be paid to the riding qualities of the turnouts.

In general, it is my observation that, irrespective of the lighter axle loads, the European railroads are not as uniform in riding qualities as those in America. From my observation, the general details of maintenance are not followed up as closely as in America. Here the railroads are trying to establish a uniform standard, but there is no indication of this in Europe. In England, however, they seem to carry on maintenance work with greater neatness than in this country. Practically all track work is done by manual labor (and apparently without difficulty) except for a few exceptions which I noted in Germany and Northern Italy. In Germany I observed a large derrick car or crane which was being used to pick up 15-meter sections of the track together with the ties, and loading them on cars. With this exception all the work is done by hand. No pneumatic, electric or similar tools were seen and apparently few if any are used. In Europe they seem to talk only in terms of manual labor.

American Problems

In my opinion, one of the greatest problems we have facing us in America today is that of the construction and maintenance of the track structure through the rail joint zone, a problem concerning which the European railroads manifest no particular concern. In the first place, Europe as a whole uses a very short and light bar and the tracks are laid with opposite joints. Joint ties are six to eight inches longer than the intermediate ties, which is also the case where steel ties are used, since they make them in special lengths for the joints. In many countries, particularly in Germany, two stand-

ard ties are bolted together for supporting the joint. This is also done in turnouts, where two switch ties are bolted together to support the toe and heel of the switch and the toe and heel of the frog. In Switzerland, the joint is supported by a twin or double steel tie especially constructed for that purpose.

On the whole, I believe that the railroads of America are comparable with, if not better than, many of the European railroads with respect to the condition of maintenance. This, I think, is largely owing to our efficient and intelligent supervision of the field forces and the insistence that proper material be furnished and installed in an efficient and workmanlike manner and then maintained to conform to a uniform standard.

Discussion

The discussion on this paper consisted mainly of questions regarding the differences in maintenance practices and organizations on the European railways as compared with those in this country. In reply to these questions Mr. Neubert explained in some detail some of the practices which are quite distinct from those in the United States but said that in other cases there was little difference.

What Are We Going to Do About It?

By S. H. CADY
General Solicitor, Chicago & North Western, Chicago

WHEN I travel the broad length of this land and see the highways of commerce, the railroads of the country, and the high state of efficiency in which they are maintained, I feel like lifting my hand in salute to the roadmasters of the country. I sometimes wonder how you manage to keep the ballast, the ties and the rails on your several railroads in such excellent condition. In fact, on some roads, knowing the financial condition of those roads, it is something of a mystery to me.

You know, whenever it is necessary to economize—and it is necessary to economize on most railroads now and then—the president says, "We have to economize, we have to cut down on this expense, we have to cut down on this maintenance." And the engineer in charge of maintenance says, "But, Mr. President, it wouldn't be safe to cut down on that appropriation for maintenance."

"Oh," says the president, "the roadmasters will manage it some way, they always do." And, gentlemen, you always do.

Love of Their Work

I have come to the conclusion that the one thing that enables the roadmasters to maintain the roads at such a high degree of efficiency is love of their work, such devotion to it, if you please, that the roadmaster knows every switch, almost every rail and almost every tie under his entire jurisdiction, rendering a service thereby, not so much, perhaps, to the company as to the public, for which money will not pay. But you can't go on patching up forever. No amount of devotion will keep a railroad tie that is rotten in service or a poor rail on a curve when a locomotive hits it 60 miles an hour. This brings me very naturally and very properly to the question: "Why not more money for maintenance?" Let us briefly review the transportation situation as it was 30 years ago and as it is now.

Thirty years ago practically all of the passenger and freight traffic moved by railroad. The stage coach was a thing of the past. It was history. The tow boat had practically gone out of existence. Freight and passengers moved by rail. What a change has taken place in the transportation of this country in this 30-year period. Then the automobile was just being invented; then the airplane was a dream; then there were but few pipe lines; then the government had not gone into the transportation business by waterways. Now, 1930, we find practically 25 million automobiles, buses and trucks chasing up and down this country on a network of pavements. And what have they done to the railroads? The best estimate is that they have decreased their passenger traffic by at least 50 per cent, or, to put it differently, that only half as many people ride now as would be riding excepting for that.

Thirty years ago there were but few pipe lines, now there is a perfect network of them extending from almost every field of importance to the points of consumption. Two or three years ago we were rather disposed to scoff at the idea that the airplane might ever become a competitor of the railroads. But the American people have become or are rapidly becoming air-minded, and we find large numbers regularly traveling that way.

We thought that the waterways were dead years ago. But some way or other they have been revived and there is now a hue and cry from the Atlantic to the Pacific and from Lake Superior to the Gulf for waterways—cheap transportation by water.

These 25 million automobiles would be impossible if it were not for the governmental assistance, federal, state, county, city and town, in building the highways on which they operate. The railroads are thus contributing to the rights of way of their competitors, the bus and truck and the private automobile, by paying taxes which have increased tremendously.

The government is also in the transportation business on the waterways. Either for political purposes or because of some local pride, or because of some other motives, a hue and cry on the subject of waterway transportation has been raised all over the country, but the people will never profit from the hundreds of millions of dollars that are being, have been and will be spent for this purpose.

A Sort of a Racket

I sometimes think that this is a sort of a "racket" on the part of some of the shippers to get lower rates, because nobody is ever going to ship anything by water who really wants it to get there. If you are a shipper and you want to ship something from New Orleans to St. Paul, you aren't going to put it on a barge—unless you want to store it.

I want you to know when you hear about lower rates by water that the railroads of the country contribute to those lower rates. We will take paper, for example. We will say that the rail rate on paper from St. Louis to New Orleans is a dollar and from Green Bay, where it is manufactured, to St. Louis is 50 cents. The rail rate from St. Louis to New Orleans is reduced on water to 80 cents, so the manufacturer of paper up at Green Bay can ship by water

for 20 cents less, and the public thinks that the water stands all of that reduction. It doesn't. Under the rulings of the Interstate Commerce Commission and by direction of Congress, the railroads stand their share. The cost by all rail is $1.50; by rail and water it is $1.30. The division is made on the two-to-one basis, so that the railroads pay one-third of the reduction in transportation by water. There are some instances where they pay more than half of it.

I want to call your attention to the large non-productive capital expenditures that are being required all the time. Everybody wants a magnificent new union station, regardless of the amount of traffic it will command. They want track elevation, but they don't want to help pay for it. They also want electrification. Why? Because the railroads are expected to pay for it.

I wish also to mention the unfair attitude of the public in condemnation proceedings and personal injury cases. Do you know there is more perjury committed in the courts of these United States in the personal injury cases against the railroads than all the other cases put together, and at times it brings our judicial proceedings into a condition where there is no basis for respect.

What Are We Going to Do About It?

What are we going to do about it? What is the country going to do about it? Can we get along without the railroads? No method of transportation, by either water, internal combustion motor or air has yet solved the problem of transporting ore, for instance, or coal. We cannot get along without the railroads in time of peace; and we can not get along without them in time of war. Twenty-five or 50 years from now the railroads will still provide the principal method of transportation, With all of the inroads that are being made upon the treasuries of the railroads, with all the excessive regulations, with all of the demands for reduced rates, with all of the clipping, if you please, of the power of the management, do we want the railroads taken over by the government? That seems to be the one solution if the railroads are not permitted to function. We had government operation of railroads in this country for 26 months and government operation showed a deficit of $1,800,000,000. Perhaps I may help you better to understand the size of that sum when I say to you that that meant a deficit in operation of $2,283,000 every 24 hours.

The railroad man has a responsibiliy to his family. He has a responsibility to the company for which he works. But he has more than that, he has a responsibility to his country. The railroad man can do much if he sees fit to do it, to turn public opinion in his community so as to eradicate some of the unjust impositions that are placed upon the railroads. It is the duty of every railroad man as a patriotic citizen to try to educate the public in treating the railroads fairly, because that is one of the important questions before us at the present time. You let the government take over the railroads and they become a tax-spending instead of a tax-paying body, which would undoubtedly spell demoralization.

Safety in Maintenance of Way Work

By J. E. LONG
Superintendent of Safety, Delaware & Hudson, Albany, N. Y.

SOMEONE has well said that the history of safety parallels the history of man. During the dark ages of his early development, the survival of the fittest and the law of self-preservation largely prevailed. Man's upward climb has continued to be a contest with danger. The history of steam railroads shows the development of many mechanical appliances designed to decrease the hazards incident to the industry. Such appliances as the locomotive whistle, the air brake, the automatic coupler, the steel passenger car, all decreased the possibility of injuries to our employees and patrons.

The present organized safety movement was started on the steam railroads about 1910, but long before that time the railroads had operating rules, and one of the oldest of these rules is that in all cases of doubt or uncertainty, the safe course must be taken.

There are many different ideas of what is meant by accident prevention, or safety first. Our idea of it is a carefully thought out plan of organized activity designed to make people think before, instead of after an accident occurs. It is based on the oldest law of man; namely, self-preservation. Since man is a creature of habits, we try to have him acquire safe habits instead of unsafe ones. Graham Wallace, in his book "The Great Society," wrote, "Habit results from repetition whether of acts or thoughts or feelings, but repetition must have a beginning, and the beginning must be due to something else than habit."

Most, if not all, accidents are unnecessary. They are the penalty of our carelessness, thoughtlessness and neglect. Organized accident prevention is a managerial function. The direct and vital interest is that of management on one hand and of labor on the other. In the final analysis, both management and labor are but men and women in slightly different walks of life. To have organization, we must first organize. The most simple and applicable definition of this word organize is, "To arrange a task in suitable parts so that it may be performed efficiently." After all is said and done, is not this what you do in your everyday maintenance work? You arrange the task in suitable parts, do the work in proper sequence, so that it may be performed efficiently, and that is exactly what you have to do with this task of preventing personal injuries.

Safe Conditions and Safe Practices

Safe working conditions are necessary; and by safe working conditions I mean safe tools and appliances. Under this head might well be included "good housekeeping," or in other words, clean working conditions. There is a joint responsibility here as between management and men. Generally speaking, management can provide safe tools and working conditions, but on the other hand, the local officers and employees must see that these safe tools and conditions are maintained by doing their part to keep them safe. Frequently material is left lying around which could easily have been put in a safe and proper place. Stumbling hazards are thus created which are the cause of serious injuries. You gentlemen of the maintenance of way department can undoubtedly do

more to make conditions safe for yourself and others than the men of any other single department of a railroad. In addition to that, you can prevent accidents by seeing that tools and other appliances with which maintenance of way men work are maintained in a safe condition.

Active safety committees are important. By active safety committees I refer to activities shown every day in the interval between the meetings, including the observance and correction of unsafe conditions and unsafe practices. This is an activity in which every man can and should participate, whether he is a member of a safety committee or not. In other words, safety is every man's job, but there is need for watching out to prevent its becoming no man's job.

As an example of what can be accomplished by safety committeemen taking their jobs seriously, it might be of interest for you to know that in 1919, the first year our present safety organization was started, members of safety committees reported over 9,000 corrections, of which 5,700 were conditions and 3,400 were practices. In 1929, last year, they reported over 161,000 corrections, of which more than 71,000 were conditions and almost 90,000 were practices. Of these 161,000 corrections last year, the maintenance of way safety committees reported approximately 90,000, or more than 50 per cent.

A Slogan

We have a slogan that "A correction a day will keep accidents away," and while this is not literally true, it is a material help. Safety committeemen make written reports of their activities and generally succeed in making a correction every working day. The committeemen enlist the co-operation of others and the correction of minor unsafe conditions and the warning against unsafe practices is an activity in which the majority of the employees have become actively engaged. Every time you correct an unsafe condition you remind others that safety is receiving consideration, and every time you warn an employee of an unsafe practice, you are helping to make him a safer man in the future.

We have classes of instruction in First Aid to the Injured. We find that when a man realizes the possible results of an accident, he is more careful to do everything within reason not to have that accident happen. Our First Aid course consists of ten lessons of one hour each, spread over a period of ten weeks. At the conclusion of the instruction classes, each member is examined by the local company surgeon and if found competent to render first aid, he is given a First Aid certificate. In addition, each track foreman who qualifies is given a complete first aid kit for use, when necessary. Practically every track and bridge and building foreman on our railroad is thoroughly qualified to render first aid to the injured.

Safety certificates are awarded to foremen for having no reportable injuries to the men under their supervision for periods of from 1 year to 20 years. The one-year certificates for the foremen of the maintenance of way department are signed by the division engineer and the safety agent. The two-year certificates are signed by the engineer maintenance of way. The three-year certificates are signed by the vice-president and general manager, the five, ten, fifteen and twenty-year certificates are signed by the president. All certificates except the one-year class are also signed by the superintendent of safety.

The foremen consider these certificates as tangible evidence of the management's appreciation of their efforts. We have found them of considerable benefit as a means of encouraging the foremen to continue their efforts to prevent personal injuries among their men.

We believe in safety rallies because it gives us an opportunity of getting together, discussing accidents and the methods of their prevention. We believe in safety bulletins because they serve as reminders for those who forget, and we all forget sometimes. We believe in the compilation and distribution of accident results. No one is interested in a ball game or any other game unless he knows the score, and the number of injuries is the score in the safety game.

During 1925, a safety committee, consisting of the division and sub-division officers and general foremen of the maintenance of way department, was organized on each division of our railroad. In 1924, the last year prior to the organization of these committees, we had 7 maintenance men killed and 253 injured (I. C. C.), or 34 casualties per million man-hours worked. Last year, 1929, we had 11.3 casualties per million man-hours worked, a reduction of approximately 70 per cent. For the first six months of this year, the casualty rate is exactly 7.0. No small portion of that reduction was accomplished on the division with which your worthy president, Mr. Crowley, is connected. For instance, in 1924, the Susquehanna division had 43.5 injuries per million man-hours worked. Last year, in 1929, it had only 16.1, and for the first six months of this year, the record is 5.1. For the first eight months of 1924, on this division, 2 trackmen were killed and 52 injured (I. C. C.), while for the first eight months of this year there were no fatalities and only four trackmen injured, the last one occurring on March 22, and none of these injuries was to men under Mr. Crowley's supervision. So far this year, the men under his supervision have worked 329,200 man-hours without a reportable injury.

Where the Credit Belongs

Lest there be any misunderstanding in your minds, I want to say that the credit for these reductions is not due to the speaker, nor to the other members of the safety department. An accident record, whether that record is good or bad, is the record of the men who make it, and the credit for this performance is due to the supervising officers and employees who made it. It is their record and to them belongs the credit. If we of the safety department have been of assistance to them, we are happy for the opportunity of rendering such assistance.

Perhaps none of the methods which I have mentioned will produce results on your respective railroads, but ways can be found which will result in materially reducing your personal injury accidents if you will give to the work your sympathetic personal support which is so vitally necessary for favorable results.

On my desk a few days ago I found a clipping, where it came from I do not know, but I am going to quote it to conclude my remarks.

"If there is one policy on earth that the accident preventionist should leave alone, it is spasmodic effort. Accident prevention does not jerk—it develops. It begins gently at first, but with proper, systematic, continuous effort it grows. Safety increases day by day, year by year, until it envelopes and dominates its surroundings with safety."

The Use of Motor Trucks in Track Work

REPORT OF COMMITTEE

O. Surprenant
Chairman

OVER a period of years the traffic handled by the railroads has increased steadily with the result that the facilities have become much more congested, especially in the larger terminals. It is essential, therefore, that at the earliest possible moment maintenance of way forces develop a substitute for the work train. The motor truck is one such substitute.

The committee recognizes the shortcomings of the motor truck as a substitute for the work train and its allied equipment for certain tasks and locations. We have in mind work at points where it is difficult or impossible for a motor truck to get in to the track and also such operations as the handling of rails, ties, etc., in quantities.

Having the above in mind, consideration has been given to the best procedure to follow to insure the most economical results for all concerned. Methods that have been effective for many years, but whose effectiveness is declining for any cause whatsoever, must be replaced if efficiency is to be maintained. If, through the opportunity provided by the use of the motor truck, efficiency can be increased with justice to the railroads at large, steps should be taken immediately to promote its use.

A primary consideration in the use of motor trucks is the extensive mileage of improved highways which are being built yearly, paralleling and crossing our rights of way, and frequently forming short cuts between two points. Such a condition cannot help but have a stimulating influence in making possible higher standards of efficiency.

The use of the motor truck by the maintenance of way department has been stimulated by the congestion in terminals and the desirability of finding a substitute for work trains and track motor cars. Some terminals, which had ample track facilities years ago, have become so congested by reason of increased traffic that it is practically impossible to obtain any service from work trains and track cars; likewise, the cost of rearrangement of these terminals is prohibitive because of their location within cities.

The Advantages of a Motor Truck

The motor truck has many advantages over the work train and the track motor car. It may be either owned or hired by a railroad, while a track car or a work train must be owned. A motor truck is a complete unit in itself, whereas a work train requires an engine to move it. A motor truck can be operated with only one man, who may also assist in the work, while a work train requires from four to five men who do nothing except operate the train. In many cases a single motor truck can perform as much work as a work train. In operation, the motor truck has the same rights as any other vehicular traffic, while on the track the work train or track motor car is held in sidings a large part of the time to allow revenue traffic to pass.

The use of a motor truck is justified wherever a saving can be shown. At some congested points it has replaced the track motor car or work train in carrying men and tools to and from work, by reason of the great saving in time brought about by using short cuts over streets and roads and the entire absence of delays due to clearing trains.

It is being used to distribute small track materials and tools, thereby replacing supply cars and consequently reducing to a minimum the amount of material held on hand on a given territory, as most of the material can be held at a central point and moved quickly with a truck when required.

The coal for small buildings scattered over a terminal or part of a division is ordinarily shipped in carload lots. These cars have to be handled by yard engines and spotted at each building, it being necessary at times to hold the engine with the car. Coal is unloaded at very great expense in this manner. By handling it with motor trucks, the car can be spotted in one location and a truck with a driver and a couple of men can distribute the coal much quicker and very much cheaper.

Grading and Ditching

During the last few years the great development in the small gasoline shovel has brought about its adoption by many railroads for ditching and drainage work. However, the use of a single shovel or ditcher does not justify the use of a work train, in which case motor trucks should be substituted; where three or four such shovels can be protected by one work train, a train can be used. In some cases, however, such a train would not be allowed to occupy the track long enough to justify its use. As an example, five such shovels were recently engaged in a ditching program on a very busy section of track on one of the large railroads, where a work train could not have had over one hour's time on the track in a day. These shovels were therefore served by 20 motor trucks and moved over 200,000 cu. yd. of material. In this case, it would have required five work trains to protect these shovels at an approximate cost of $750 per day, and only one hour's work would have been secured from each work train, whereas the 20 motor trucks kept the shovels working continuously and cost only $400 per day. Under this condition, the work trains would have cost $150 per hour and the material $4.05 per cu. yd., while the trucks cost $50 per hour and the excavation 30 cents per cu. yd. The difference in cost per yard results primarily from the fact that the work trains could not have worked over one hour and would have moved only about 300 cu. yd. per day, while the trucks worked eight hours and moved 1,400 cu. yd. In cuts of such materials as blue clay or gumbo, in which the nature of the earth is such that the use of motor trucks would be impractical, the material should be handled by large shovels wherever it would justify the use of a work train.

In the development of the safety movement, which is under way on all railroads in the United States, it

has been found much safer to move men at night, in emergencies, by motor trucks than by track motor cars. The forces can reach the scene of the accident much quicker and do considerable work prior to the arrival of the wrecking crane. The trucks need not be held at the scene unless their services are required but can be used to bring up fresh relief gangs at intervals as well as food and supplies.

Handling Snow

In the central and northern parts of the United States, where snowfalls are more or less heavy, a great amount of money has been and is being wasted by rehandling snow many times in yards and terminals, particularly about ladder tracks, turntable pits, repair trucks, around buildings, passenger and freight platforms, freight transfers and along sidewalks, streets and roadways. As soon as the snow stops falling, its immediate loading into dump trucks for tranportation to dumping grounds will save rehandling and will also prevent its blowing back onto the tracks again, which is likely to occur when it is piled nearby. Also, unless snow is removed from the immediate vicinity at such points as these, traffic soon drags it back again. Many railroads pass directly through the streets of towns and cities and local ordinances will not permit the operation of standard snow equipment at these points. Therefore, all snow has to be loaded and removed from the vicinity and the motor truck is the simplest and cheapest agency to use.

On nearly all railroads there are a number of private roadways leading from the tracks and buildings, and in order to maintain them properly it is necessary to employ motor trucks to handle the material with which to repair them.

Miscellaneous Uses for Trucks

We have found that where it is necessary to save small buildings, they can often be loaded upon motor trucks and transferred to other points much more quickly and cheaply than by work trains. Also, after larger buildings have been placed upon runways, one or more motor trucks can be used to haul them to their new locations.

Where miscellaneous scrap bins are located at various points in a large terminal, motor trucks can be used to transfer the scrap from these bins to a central scrap dock where it may be dumped directly into cars without further rehandling. This eliminates all engine service for this purpose.

Where small track machines have become disabled or require general overhauling, it has been found much cheaper to send a motor truck to transport them to the repair shop than to resort to other means.

On many railroads, motor trucks have been used in excavating embankments along the highways at public crossings where the vision is obstructed by these embankments and where traffic is not heavy enough to warrant the elimination of the crossing. These motor trucks can take advantage of the dumping areas along the highway, securing a short haul and accomplishing work which would be highly expensive if performed by work trains. Many railroads are taking advantage of this, as it not only promotes safety but gives much better drainage to the track at these points and can be done without interference with traffic.

Where small repairs are being made to bridges or culverts at points which can be reached by truck, and material is required in less than carload lots, this material can be handled by motor truck much cheaper than by any other means.

Three of the Motor Trucks Owned and Operated by the Great Northern

Motor trucks have been almost universally employed by the railroads for the cleaning of rubbish from the vicinity of team tracks as they can do this at any time of the day or night, whereas, if this work were performed by work trains as in former years, it would be necessary to do it at night to prevent interference with cars spotted for shippers; it would also be necessary to switch these tracks in order to enable the work train to reach the site.

Transporting Men

One eastern railroad is relocating one of its main tracks for a distance of 10 miles, at an average distance of 12 miles from the home terminal. This work is being handled with an extra gang of 60 men, who have their headquarters at the latter point. When the work was first started these men were transported to and from work on a regular work train used on this job which is scheduled to leave the terminal every day at 7:00 a. m. It was found, however, that much time was lost by reason of the necessity of the work train clearing revenue trains, traffic being very heavy between six and eight o'clock in the morning. At times as much as two hours' time was lost by this gang in going to work. At night this same work train had to go to another terminal and then return to the home terminal via the opposite main track, which is located on the opposite side of a valley. In making this movement, the train became involved in heavy traffic through an interlocking plant and the gang again lost time in returning home.

The company, therefore, hired two motor trucks which it equipped with seats, and these trucks made the trip with this gang each way in 30 min. The value of the total lost time in using the work train for these men averaged $60 per day while the truck hire amounted to $20 per day for the two trucks. There was, therefore, a saving of $40 per day and as the job will last approximately four months, the total saving will be in the neighborhood of $3,600.

A short time ago another railroad was engaged in a grade-crossing elimination job at a point 36 miles from the home terminal by rail. Again it was found that much delay was encountered in going to and from work by either work trains or track motor cars. In this case the gang consisted of about 30 men. One motor truck was hired for this work at a cost of $10 per day, and it was found that, owing to the peculiar location of the railroad in this territory, the distance to the work via highway was only 19 miles. The total saving on this job, which lasted two months, was $2,300. In this case a considerable saving was also made through the use of motor trucks to transport the men to and from work by reason of the fact that this permitted the work train to be tied up on the job rather than run to and from the home terminal.

In each of the above cases, where motor trucks were used for transporting men, it was insisted that the trucking concern assume entire responsibility for the men's safety, and there was no trouble in getting them to insure their trucks for this purpose. The trucking concerns also relieved the railroad of all responsibility for accidents or damage caused by their trucks.

During sleet storms, the motor truck again comes into play. When track motor cars cannot be operated on icy rails, trucks have been substituted to take large gangs of men to and from work.

Where there have been short, deep washouts, which necessitated the building of a temporary trestle in order to fill them by work trains, trucks have been used and the filling completed before it would have been possible to have collected the material for the temporary trestle at the scene. The same holds true in the case of small fills made for construction purposes, the filling of swamps or other places away from the tracks or the making of small excavations, any of which would require the building of a temporary track to reach the point with a work train. This work can all be performed by motor trucks without any other expense.

The data presented in the table were obtained from large trucking contractors and manufacturers and is the approximate average cost of operation in the northeastern states.

Cost of Operating Trucks per Day

Capacity in tons	1	1	1	2	2	2	3	3	3	5	5	5
Gasoline—miles per gal.	15	15	15	7	7	7	6	6	6	4	4	4
Miles operated per day	40	60	100	40	60	100	40	60	100	40	60	100
Interest	.19	.19	.19	.28	.28	.28	.44	.44	.44	.76	.76	.76
Insurance	.23	.23	.23	.26	.26	.26	.28	.28	.28	.64	.64	.64
Drivers' wages	5.75	5.75	5.75	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Garage	.50	.50	.50	.70	.70	.70	.80	.80	.80	.80	.80	.80
License	.12	.12	.12	.20	.20	.20	.41	.41	.41	.58	.58	.58
Gasoline, at 16 cents per gal.	.40	.60	1.00	.80	1.20	2.00	1.08	1.62	2.70	1.60	2.40	4.00
Lubricants	.12	.18	.30	.16	.24	.40	.16	.24	.40	.20	.30	.50
Tires (20,000 miles per set)	.24	.36	.60	.62	.94	1.57	.96	1.44	2.40	1.20	1.80	3.00
Overhauling (5 times per 100,000 miles)	.38	.57	.95	.40	.60	1.00	.50	.75	1.25	.60	.90	1.50
Painting	.04	.07	.11	.06	.09	.10	.12	.18	.30	.12	.18	.30
Running repairs	.38	.57	.96	.47	.71	1.19	.64	.96	1.60	1.00	1.50	2.00
Depreciation (100,000 miles)	.68	1.03	1.72	1.14	1.72	2.87	1.52	2.29	3.82	2.37	3.56	5.94
Total cost per day	9.03	10.17	12.43	11.09	12.94	16.57	12.91	15.41	20.40	15.87	19.42	26.50

Conclusion

In large terminals, such as New York, Chicago, Boston, Baltimore, etc., there is no question but that motor trucks can be and are being used to advantage and that a great deal of money is being saved, but, as the terminals become smaller, the continuous use of a motor truck to advantage becomes a problem which can only be solved by hiring trucks by the hour from a contractor, until such times as the user has sufficient work to keep a truck busy for eight hours each day. The selection of the make, type and capacity of the truck must be left to the individual railroad, as there is a wide variation in requirements. The motor truck has a place in our track organization just the same as the work train, but in order for it to be a profitable investment the proper truck must be selected for the work in hand, and it must be given the best supervision possible.

For emergency work the value of the motor truck is incalculable, and where there is not sufficient work to justify a railroad in owning a truck, arrangements should be made with a reliable local trucking concern so that at least one truck is available for use at all times.

In a large terminal where a number of trucks are employed, the organization should conform as nearly as possible to that maintained by the most prosperous local trucking concern, thus insuring efficiency in handling the trucks.

From its investigation, this committee has found that a number of railways in the United States are operating as many as 50 motor trucks in their bridge and building, and signal and stores departments, with great savings, but that these same railroads are using only a few trucks in the track department. The only reason we can find for this is that the track department has always had easy access to work-train service; in fact, the operation of work trains has been such a routine matter that we feel at times that work trains have been kept in service merely to hold the regular crew. This has retarded the track department in advancing into the field of motor-truck operation. On other railroads the track department has been the pioneer in the use of motor trucks. We believe that if each railroad were to make an intensive study of work-train service in the track department and substitute motor trucks for work trains where practicable, a great saving would be made.

Committee: O. Surprenant, chairman, roadmaster, D. & H., Schenectady, N. Y; C. F. Allen, C., M., St. P. & P., Milwaukee, Wis.; G. G. Austin, general roadmaster, C. J., Chicago; John Barth, supervisor, C., C., C. & St. L., Mattoon, Ill.; W. A. Clark, supervisor, Reading, Trenton Jct., N. J.; W. E. Carter, supervisor, B. & L. E., Greenville, Pa.; C. F. Edwards, assistant cost engineer, C. & O., Huntington, W. Va.; J. O.

Heap, Penna., Baltimore, Md.; R. Keesler, assistant engineer maintenance of way, Union Traction Co., Anderson, Ind.; P. F. Maisenbacher, roadmaster, E., J. & E., Gary, Ind.; John O'Leary, roadmaster, G. N., Minneapolis, Minn.; H. G. Watkins, engineer maintenance of way, A., C. & Y., Akron, O.

Discussion

P. J. McAndrews (C. & N. W.) testified as to the advantage of employing a truck in connection with track maintenance on a section involving about 20 miles of yard tracks. This truck is used to handle men and materials, including the hauling of ties from 1½ to 2 miles, at a cost of two cents per tie. The cost of owning and operating the truck is about $3 per day and it saves the time of from three to four men on this section. W. Ryan reported that the B. & O., New York Terminal Lines had effected marked savings by hauling coal for watchmen's shanties, small stations, etc., by truck. The cost is 50 cents a ton as compared with as much as $10 a ton when hauled by train. In this operation the trucks are hired at a cost of $12 a day. On the Illinois Central at Chicago, according to J. J. Desmond, a fleet of trucks is in constant service handling various classes of materials. He said that the operation of the trucks is watched very carefully for the purpose of checking up the drivers' accident records. Every street accident is investigated in exactly the same way that railway accidents are followed up.

Considerable attention was given the subject of liability insurance and it was agreed that especial care should be taken to see that no truck, either company owned or hired, should be operated until it is certain that there is adequate insurance coverage. Mr. McAndrews favored ownership of the truck by the railroad, whereas Mr. Ryan contended that it had been found cheaper to hire the trucks. With respect to this phase of the problem, as well as the question of the economies to be derived from truck operation, both C. W. Baldridge (A. T. & S. F.) and Elmer T. Howson *(Railway Engineering and Maintenance)* pointed to the fact that no general rules can be drawn up, but that each case must be investigated individually. Mr. Baldridge stated that one railroad was providing cars for its water-service repairmen and that another road was equipping its local engineer corps with them. A. M. Clough (N. Y. C.) pointed out that the principal limitation to the use of trucks is the fact that they cannot reach all parts of the right of way because of the absence of any road or highway. In view of this, he wondered if the time has not come when the railroads can consider the practicability of providing a lane or road along the right of way in locations where work-train service must be conducted on an uneconomical basis.

The Track Supply Exhibit

WHILE by no means as old an institution as the Roadmasters' Association, the Track Supply Association, which is now in its nineteenth year, has come to be recognized as an established complement of the older organization. In fact, it is significant that the present effectiveness and prosperity of the Roadmasters' Association was the result of a steady growth that had its beginning at about the time that the Track Supply Association was organized. The number of exhibitors who presented displays of appliances and materials this year was 68, the largest number of firms ever participating in any exhibit of the Track Supply Association.

The officers of the Track Supply Association who have been responsible for the preparation and conduct of the exhibit are: President, L. P. Shanahan, representative, American Steel & Wire Co., Chicago; vice-president, D. J. Higgins, representative, American Valve & Meter Co., Chicago; secretary-treasurer, L. C. Ryan, representative, Oxweld Railroad Service Company, Chicago; directors, G. M. Hogan, vice-president, Sellers Manufacturing Company, Chicago; W. B. Maurer, assistant to vice-president, American Hoist & Derrick Co., St. Paul, Minn.; L. S. Walker, eastern manager, P. & M. Co., New York; and G. T. Willard, representative, Railroad Supply Company, Chicago.

In the election of officers, Vice-President Higgins was advanced to president; Mr. Willard was elected vice-president; and Mr. Ryan was re-elected secretary-treasurer. Mr. Walker and Mr. Hogan were re-elected as directors for one year and E. Keough, representative, American Fork & Hoe Co., Chicago, was elected director for two years.

List of Exhibitors

Achuff Railway Supply Company, St. Louis, Mo.; rail anchors, lock washers, track wrench; W. D. Achuff and G. W. Achuff.

American Chain Company, Inc., Reading Specialties Division, Reading, Pa.; guard rail clamps, guard rails, rail benders, rail brace and compromise joints; J. J. O'Connell, M. L. Johnson and W. I. Clock.

American Fork & Hoe Co., Cleveland, Ohio; rail anchors, tapered rail joint shims, forks, rakes, scuffle hoes and broom rakes; A. F. Fifield, S. L. Henderson, J. T. Reagan, E. Keough, F. C. Stowell, R. C. Violett, J. J. Nolan and J. H. Dooling.

American Hoist & Derrick Co., St. Paul, Minn.; illustrations and photographs of locomotive cranes and ditchers; Ward B. Maurer, Helen Hoeller, A. Harvey, A. Craine, J. L. Hickey and D. L. O'Brien.

American Steel & Wire Co., Chicago; fencing materials, signal wire, bonds, wire rope, nails and concrete reinforcement; A. W. Froude, C. A. Cochrane, L. P. Shanahan, E. E. Aldous, W. Floto, C. S. Knight, C. F. Wiley and R. Francisco.

American Valve & Meter Co., Cincinnati, Ohio; wheel flange and rail lubricators, switch stand, rail joint clamp and switch interlocker; J. T. McGarry, J. W. McGarry and D. J. Higgins.

Bethlehem Steel Company, Bethlehem, Pa.; steel ties, rail anchors, switch stands, guard rail, gage rods, rail and wheel contour machine and track bolts; N. E. Salsich, R. P. Deghuee, C. H. Cecil, J. L. Tygart, G. L. Moore, G. Oyer, G. Riddle, C. Y. Phillips, C. W. Johnson, K. F. Beary, R. L. Gillispie and F. M. Hoffman.

Boss Bolt & Nut Co., Chicago; lock nuts; H. E. Burns and George Hanley.

Buda Company, Harvey, Ill.; motor cars, jacks, track liners, rail benders, track drill, section of motor-car engine; R. B. Fisher, H. M. Sloan, R. M. Blackburn, J. T. Jung, E. H. Walker, G. A. Secor and E. L. Kastler.

Caterpillar Tractor Company, Peoria, Ill.; Model 15 caterpillar tractor, moving pictures of caterpillar operation on railroads; O. E. Andren and H. L. Wagner.

Chausse Oil Burner Company, Elkhart, Ind.; switch heaters and kerosene torches; McKay White, E. R. Mason and C. P. Dearman.

Chipman Chemical Engineering Company, Inc., Bound Brook, N. J.; chemical weed killers, literature; J. K. Aiman and J. T. Darby.

Creepcheck Company, Inc., New York; rail anchors; R. R. Dinklage, T. D. Crowley, N. A. Howell and V. L. Walker.

Crerar, Adams & Co., Chicago; tools; Russell Wallace, E. C. Poehler, R. M. Bullard, W. L. Riedell, G. D. Bassett, J. M. Temple, J. H. Ruel and O. H. Sneed.

Cullen-Friestedt Company, Chicago; motion picture of rail and locomotive cranes in operation; F. P. Cullen, William C. Bamber, E. V. Cullen, R. W. Payne, G. H. Penglase, F. J. Reagan and C. J. Bronez.

Duff-Norton Manufacturing Company, Pittsburgh, Pa.; track jacks and tie spacers; C. N. Thulin and Dave Evans.

Electric Tamper & Equipment Co., Chicago; two-tamper power units and electric tampers; C. Jackson, V. G. Cartier, M. S. Westlund, H. W. Cutshall and Roy Cartier.

Enterprise Railway Equipment Company, Chicago; illuminated photographs of box, hopper, gondola and ballast cars; motion pictures of ballast car in operation; Walter L. Gunnison; Richard T. Coyne, Edward F. Scheck and George B. Dorey.

Fairbanks, Morse & Co., Chicago; motor cars; B. S. Spaulding, F. M. Condit, J. L. Jones, E. C. Golladay, P. H. Gilleland, H. J. Smith, G. W. Lewis, J. A. Sleer, R. F. Lane and T. M. Eaman.

Fairmont Railway Motors, Inc., Fairmont, Minn.; motor cars, motion pictures of weed burner, mowing machine and discer; Albert C. Force, W. F. Kasper, Robert D. Sinclair, K. K. Cavins, A. R. Fletcher, W. D. Brooks, V. Pagett, C. H. Johnson, C. P. Benning and C. F. Green.

Hayes Track Appliance Company, Richmond, Ind.; models of derails and bumping posts, Herbert J. Mayer, Ivan M. Druley, Charles L. Starr and Brice E. Hayes.

Hopkins Company, Chicago; tie tamping machine, track-barrow, one-rail maintenance car, gasoline-driven grinder; C. F. Hopkins, Thomas J. Lynch and B. F. Gehr.

Hubbard & Co., Pittsburgh, Pa.; shovels, track tools and nut locks; J. S. Wincrantz.

Industrial Brownhoist Corporation, Cleveland, Ohio; photographs of gasoline and steam locomotive cranes and ditchers; C. H. White, G. F. Climo, Jr., and G. L. Harman.

Ingersoll-Rand Company, New York; pneumatic tie tamper and other pneumatic track tools, rock drill, concrete breaker, wire brush, wood borer, grinders and scaling tool; W. H. Armstrong and G. W. Morrow.

O. F. Jordan Company, East Chicago, Ind.; moving pictures of spreader and track oiler; J. M. Mullholland, J. C. Forbes and H. M. McFarlane.

Kalamazoo Railway Supply Company, Kalamazoo, Mich.; motor cars, section of inspection-car engine, track levels and gages; F. E. McAllister, R. E. Keller and L. W. Bates.

Keystone Grinder & Manufacturing Co., Pittsburgh, Pa.; tool grinders; L. J. Cooney and S. S. Newman.

Koppel Industrial Car & Equipment Co., Koppel, Pa.; photographs of air dump cars; F. C. Dankmyer, H. W. Redman and H. E. Chilcoat.

Lundie Engineering Corporation, New York; tie plates; L. B. Armstrong and Eugene Brandeis.

Maintenance Equipment Company, Chicago; switch point protector, rail and flange lubricator, model of friction car stop, literature on power tools, lubricators and fence posts; D. M. Clarke, R. J. Shanahan, T. E. Rodman, H. E. Muhs, E. Overmier and Clifford Hogan.

Mechanical Manufacturing Company, Chicago; bumping post; H. E. Johnson.

Morrison Railway Supply Corporation, Chicago; reclamation of frog and switch material; C. J. Diver, E. W. Smith, R L. Morrison, M. B. Morrison, Robert Alphont and George Lamborn.

National Carbide Sales Corporation, New York; carbide flood lights and lanterns; R. C. Holcomb, E. C. Ackerman, F. E. Mull, G. Van Alstyne and C. E. Daly.

National Lock Washer Company, Newark, N. J.; spring washers; W. R. Hillary, R. L. Cairncross, W. E. Bugbee and O. E. Sutherland.

Nordberg Manufacturing Company, Milwaukee, Wis.; adzing machine, power rail drill, spike puller and jack, and motion pictures of this equipment; W. W. Fitzpatrick, Victor F. Larson, H. H. Talboys, E. R. Mason, Chester Clemens, Clyde Jensch and Gus Geer.

Northwestern Motor Company, Eau Claire, Wis.; motor cars, cut out model of motor-car engine; A. H. Nelson, F. W. Anderson, Otis B. Duncan, Allan Datesman, O. Phillip and G. H. Goodell.

Orton Crane & Shovel Co., Chicago; literature on cranes and shovels; P. A. Orton, Jr., and A. R. Whitney.

Oxweld Railroad Service Company, Chicago; welding and cutting apparatus, carbide lights, motor-car lights; L. C. Ryan, W. F. Kofmehl, J. E. Winslow, F. J. Duffie, D. H. Pittman, M. C. Beymer, W. Leighton, E. S. Richardson, H. W. Schulze, J. G. Tawse, J. J. Saelens, F. C. Hasse, E. Cordeal, A. N. Lucas, W. A. Hogan, W. Jones, J. D. Dunbar and R. J. Nenneman.

P. & M. Co., Chicago; anti-creepers and bond-wire protectors; L. E. Borst, D. T. Hallberg, G. E. Johnson, J. E. Mahoney, C. E. Webster, L. S. Walker, J. J. Gallagher, S. M. Clancey, W. A. Maxwell, W. G. Cunningham, P. H. Hamilton and R. W. Payne.

Pettibone Mulliken Company, Chicago; switch stands, mechanical switchman and manganese guard rails; G. J. Slibeck, A. W. Swartz and C. A. Johnson.

Pocket List of Railroad Officials, New York; copies of Pocket List of Railroad Officials; B. J. Wilson.

Positive Rail Anchor Company, Chicago; rail anchors and guard rail plates and braces; A. H. Told and L. C. Ferguson.

Protectoseal Company, Chicago; safety appliances for handling volatile liquids; C. T. Leonard and C. R. Peck.

Q & C Co., New York; guard rail clamp, tie plate and clamp, compromise joint, flangeway guards, derails, guard rails and foot guards; J. L. Terry, L. Thomas and L. E. Hassman.

Rail Joint Company, New York; insulated and standard joints; Alexander Chapman, H. C. Hickey, C. B. Griffin, J. N. Meade, Milton Markley, G. L. Brittingham, Thomas Ryan and G. H. Larson.

Railroad Supply Company, Chicago; tie plates; George T. Willard, John Hansel, E. H. Bell, R. E. Bell, H. M. Buck, W. S. Boyce, R. B. Archibald and Arthur C. Dunne.

Railway Engineering and Maintenance, Chicago; copies of *Railway Engineering and Maintenance* and *Railway Age;* Elmer T. Howson, F. C. Koch, J. M. Rutherford, W. S. Lacher, M. H. Dick, G. E. Boyd, J. G. Little, H. A. Morrison, W. N. Yadon and H. E. McCandless.

Railway Maintenance Corporation, Pittsburgh, Pa.; motion pictures of ballast-cleaning machines; J. B. McWilliams and J. F. Casey, Jr.

Railway Purchases and Stores, Chicago; copies of Railway Purchases and Stores; Edward Wray, K. F. Sheeran, H. B. Kirkland and J. B. Murphy, Jr.

Railway Track-Work Company, Philadelphia, Pa.; power track grinders; A. M. Nardini and Henry Perazzoli.

Ramapo Ajax Corporation, Hillburn, N. Y.; full-size model split switch, switch stands, manganese flange switch guard, switch and guard-rail accessories and rail expander; T. E. Akers, W. Bender, G. M. Cooper, J. E. Davidson, D. Fairback, W. J. Fairback, D. F. Hilton, P. Hoffman, J. V. Houston, John Hutchins, G. A. Carlson. R. W. Payne, J. B. Strong, W. A. Peddle, H. W. Renick and W. Perdue.

Rawls Manufacturing Company, Streator, Ill.; weed-cutting machinery; S. E. Rawls and N. H. Greer.

Reade Manufacturing Company, Jersey City, N. J.; moving pictures of chemical weed killing; R. W. Pritchard and D. M. DeWitt.

Reliance Manufacturing Company, Massillon, Ohio; spring washers; Robert Shireman, H. J. McGinn, E. D. Cowlin, E. C. Gross and A. L. Weston.

Republic Steel Corporation, Youngstown, Ohio; guard rail assembly, tie rods, nuts, bolts, spikes, rivets, turnbuckles, tie plates and perforated iron drains; C. H. Aiken, L. L. Solger and A. D. McAdam.

Sellers Manufacturing Company, Chicago; wrought iron tie plates; R. A. Van Houten, George M. Hogan, R. J. Platt and N. J. Leavitt.

Skelton Shovel Works (American Fork & Hoe Co.), Dunkirk, N. Y.; track shovels, spades and scoops; E. W. McCarty, H. C. Branahl and C. A. Trigg.

Standard Oil Company of Indiana, Chicago; samples of asphalt products and literature; E. P. Keane, E. F. Tegtmeyer and G. Combs.

Superior Flake Graphite Company, Chicago; graphite curve grease; Walter R. Pflasterer and W. S. Joyce.

Syntron Company, Pittsburgh, Pa.; literature and photographs of tie tampers and other power track tools, power units and power cars; E. D. Jackson and D. G. Black.

Templeton, Kenly & Co., Ltd., Chicago; jacks and tie-spacing shoes; W. B. Templeton, George Mayer, C. A. Crane, W. H. Kreer and William Simpson.

Union Switch & Signal Co., Swissvale, Pa.; hand-operated switch mechanism; J. J. Cozzens.

Warren Tool & Forge Co., Warren, Ohio; track tools; Howard Mull and J. A. Martin.

Western Wheeled Scraper Company, Aurora, Ill.; working model of dump car, moving pictures and photographs; Jay Huber and Jess Mossgrove.

Wheeler Track Gauge Company, Gering, Neb.; moving track gage; Walter Yensen and Arthur Yensen.

Woodings Forge & Tool Co., Verona, Pa.; track tools, rail anchors and reformed angle bars; R. J. McComb, C. L. Woodings, Russell Wallace and E. C. Poehler.

Woolery Machine Company, Minneapolis, Minn.; power bolt tightener, literature on weed burners, snow and ice melters and bolt tighteners; C. H. Smith, Jr., and Garrit Ye.

Non-Exhibiting Members

Air Reduction Sales Company, New York.
Bucyrus Erie Company, South Milwaukee, Wis.
Thomas A. Edison, Inc., Bloomfield, N. J.
Electric Railweld Sales Corporation, Chicago.
Indianapolis Switch & Frog Company, Springfield, Ohio.
National Malleable & Steel Castings Company, Cleveland, Ohio.
Prendergast Company, Cleveland, Ohio.
Rodger Ballast Car Company, Chicago.
Verona Tool Works, Pittsburgh, Pa.
Wm. Wharton, Jr., & Co., Chicago.
Wyoming Shovel Works, Wyoming, Pa.

WHAT'S THE ANSWER?

Have you a question you would like to have someone answer?

Have you an answer to any of the questions listed below?

QUESTIONS TO BE ANSWERED IN THE DECEMBER ISSUE

1. *What precautions should be observed in the use of claw bars to avoid creating hazards to track men?*

2. *What are the relative advantages and disadvantages of floodlighting and of individual lamps for illuminating station platforms?*

3. *What is the best method of erecting portable snow fences in cases where they are placed on cultivated land and must be removed early in the spring while still surrounded by deep drifts and the frost is still in the ground?*

4. *What are the advantages and disadvantages of permanent headwalls for pipe culverts?*

5. *How many men are required in renewing a turnout? How should they be organized? What sequence should be followed in removing and placing the various parts?*

6. *What is the proper spacing for hydrants in coach yards and at other points where passenger cars are cleaned and watered?*

7. *Should relayer rail from tangent track be laid with the original gage side in or out? Why?*

8. *When placing concrete in the winter what are the advantages and disadvantages of heating the mixing water? What, if any, precautions should be observed?*

Gage Through Crossings

What was the reason for the practice formerly followed in some quarters of narrowing the gage of the track through railway crossings? Is the practice still in vogue? If not, why was it discontinued?

The Gage Through Crossings Was Never Narrowed

By G. J. SLIBECK
Sales Manager, Pettibone Mulliken Company, Chicago

During my experience of 11 years as an assistant engineer, roadmaster and division engineer and my later connection for 15 years with the manufacture of trackwork, I have never known of a case where the gage was purposely narrowed through a railway crossing. The present practice, followed very generally, is based on the requirements of the specifications adopted by the American Railway Engineering Association, which allows a tolerance of only ⅛ in. less or 1/16 in. more than the gage specified in manganese construction and only 1/16 in. more or less for bolted crossings. So far as I know, manufacturers have always worked within these limits.

All crossings, regardless of the type of construction used, show a tendency to narrow their gage after being placed in service, the amount of this tightening depending on the design, the type of construction and the character of the maintenance. This action is most noticeable in bolted crossings in which the angle of intersection lies between 45 deg. and 90 deg. There is a definite reason why this is so. Such a crossing is made up of a number of parts placed adjacent to each other and held in position by bolts. Any movement over such a structure causes vibration which shakes the oxidized scale from the various parts and eventually necessitates the retightening of the bolts. This shortens the gage and the flangeway is generally narrowed through the tipping of the rail.

Where the angle of the crossing is less than 45 deg., the tendency to narrow the gage is not quite so marked, but another trouble is introduced by the tendency to get out of line. This is the result of the wheels striking one corner of the crossing before it reaches the others. The same thing occurs with manganese crossings, but not to so great an extent, since there are not so many parts bolted together. The tipping over in manganese structures is not so noticeable as in the rail crossings, because, owing to the nature of the metal, there is more rapid abrasion than in the open-hearth steel.

For these reasons, it is obvious that the better the maintenance the more detrimental it becomes to this particular feature in bolted crossings, since the oftener and more intensively the bolts are tightened, the more quickly will the gage narrow.

Better Construction and Heavier Rail Caused Discontinuance of Practice

By G. STAFFORD
Section Foreman, Canadian National, Rosebud, Alta.

The practice of making the gage at railway crossings ¼ in. to ⅜ in. narrower than at other places in the track was adopted in order to lessen to some extent the sidewise motion or play of the wheels of rolling stock, caused by the clearance or difference between the gage of the flanges of the wheels and the gage of the track, and so prevent the wheels from striking against the points of the crossings. This was a universal practice on British railways, and the gages of the track forces had the measure or gage

for crossings shown on them by a slight offset on the prongs, halfway of their height.

On American roads, on the other hand, the practice was favored only in certain quarters. Possibly, with the type of crossings and turnout frogs that were then in use in the early days of the railways, together with the old fashioned "home-made" guard rail and its insecure fastenings, some benefit may have accrued from the practice. Subsequent improvements in the design and fabrication of crossing, frog and guard rail structures, the introduction of manganese steel into their construction, the advent of the spring frog, and the progressive development in the weight of the rail rendered unnecessary any such remedial action as a divergence from the uniform gage of the track.

Disposal of Waste Water

What means can be employed to dispose of waste water at water columns quickly to avoid unsatisfactory track conditions?

The Track Should Be Well Drained

By R. H. Gilkey
Division Engineer, Central of Georgia, Savannah, Ga.

When a pit is built for installing a water column, two things should be given special attention—space and drainage. The pit should be made of sufficient size to accommodate the main valve, the relief valve and a gate valve and give ample room so that the repair men will have easy access to these parts. The pit should be covered with a reinforced concrete top and should be designed with a drain leading from the tracks to carry all waste water to a sump in the pit, which is separate from and deeper than the valve space in order that this part of the pit may be kept dry for the workmen. In addition to providing the sump and drain, which should have a satisfactory outlet to insure that there will be no accumulation of water in the pit, the track in the vicinity of the water column should be ballasted with crushed stone or slag in order to insure quick disposal of any water that is wasted when filling engine tanks.

A Separate Drain Is Desirable

By Engineer Maintenance of Way

Water may be supplied to locomotives by means of a water column or through a spout attached to the service tank. The older types of water columns wasted large amounts of water, if the locomotive tank was higher or lower than the height for which the water column was adjusted. Recent designs with adjustable spouts reduce this form of waste to a minimum, so that now the principal source of waste at water columns is the flooding of the locomotive tank or the failure to spot the engine properly. No comparable improvement with respect to adjustment for high and low tenders has been made in tank spouts, so that when they are used there still remains both causes for waste, and any discussion of the disposal of waste water should include such provisions at both water columns and tank spouts.

The effect of wasting large quantities of water is to soften the roadbed and, in the northern sections of the country, this induces heaving during the winter. In addition, the accumulation of ice during this season is frequently a matter of serious concern, which can often be avoided only by the application of considerable unproductive labor. Adequate means for quick and complete disposal of water thus becomes a matter of the greatest importance.

The plan which I have used with the greatest success is to construct a catch-basin directly under the outlet of the tank spout or of the water column when they are swung to operating position. The top of the catch-basin is placed slightly below the level of the subgrade, which is sloped back for about 10 ft. and compacted, and a closely spaced grating is used for a cover. An 8-in. cast iron or tile drain, laid 6 ft. to 8 ft. below the subgrade, or as deep as conditions permit, connects the catch-basin with a manhole located a short distance away from the track, and a tile drain furnishes an outlet for the manhole.

The track is then ballasted with clean, hard, crushed stone which contains a minimum of the smaller sizes, in order to insure rapid drainage, and care is used to see that it is kept clean. With some kinds of stone which show a tendency to pulverize under tamping or in certain localities, as in yards, where the ballast fouls quickly, we have found it desirable to dig the stone out and replace it with new material at irregular intervals.

As might be expected, during extreme winter conditions, while the bulk of the wasted water is drained away, there may still be a considerable accumulation of ice. In one instance, where a steam-operated water station was near by, we piped the exhaust from the pumps to the manhole and found that this materially bettered the conditions. Later we did this at several other plants and also ran a coil into the valve pit of the water column, which eliminated the trouble we had occasionally experienced with freezing. At another location, where the pump house was close to the tank, we piped the exhaust from the oil engines to the manhole with equal success.

At another water station we designed the pit for the water column with a sump which was intended to take the place of the manhole. This scheme was not a success, however, since the cold air which entered from the catch-basin caused the water column to freeze. Such an arrangement might be advantageous in a milder climate, but our experience indicates it is not desirable where low temperature can be expected.

Anchor Bolts

When it becomes necessary to drill holes in stone or concrete to receive anchor bolts, what is the best method of securing the bolts in the holes?

Finds Grouting Is Most Satisfactory

By O. F. Dalstrom
Engineer of Bridges, Chicago & North Western, Chicago

Anchorages that are placed after the structure is erected fall into two classes, (1) those serving to hold the structure against lateral displacement, such as anchor bolts for bridge spans, and (2) those that must resist tension, such as anchorages for handrailing.

The practice on the Chicago & North Western in setting anchor bolts for bridge bearings is to pour grout into the hole in the concrete until it is nearly full. The anchor bolt is then put down, the grout filling the hole completely and overflowing at the top. This is a very quick and economical method of providing effective anchorage. The holes in the concrete must be of ample size to allow inserting the anchor bolt easily and to furnish space for the overflow of the excess grout.

For anchor bolts which must resist small amounts

of up-lift, such as for handrailing, dependence is placed on expansion bolts with lead sections on the end of the bolt. These sections are expanded by means of special tools after the bolt has been placed in position in the concrete. The space above the lead sections is then filled with grout, simply to keep out the water. At one time we used sulphur for setting anchor bolts for handrailing, but this has been practically discontinued. To get anchor bolts properly set with sulphur requires special equipment for heating the sulphur on the job, and extreme care in placing it around the bolts. In very cold weather and with a small space between the bolt and the inside of the hole, the sulphur is likely to become chilled when it strikes the cold metal and concrete, and may penetrate only a short distance below the surface of the concrete. When this occurs, it results in a weak anchor, but there would be nothing to show that it was weak until the anchorage failed.

I have not discussed the type of anchorage required for signal bridges, viaduct towers and other similar structures that require positive anchorage against up-lift, as they were apparently not contemplated in the question. Such anchorage can be provided satisfactorily only by setting the anchor bolt deep in the concrete when the concrete is placed. It is usual to provide, near the top of the concrete, short lengths of pipe with the inside diameter considerably larger than that of the anchor bolt, so that the anchor bolt can be given a slight adjustment to allow for inaccuracy in setting. These pipes are filled with grout poured in through channels under the base plate after the superstructure has been erected.

Holes Should be Large Enough for Expansion Bolts

By R. H. Gilkey
Division Engineer, Central of Georgia, Savannah, Ga.

When structures are to be anchored and the anchor bolts have not been placed during the construction of the masonry, the best plan is to drill the holes at the proper places, making them of sufficient size to permit the insertion of expansion bolts. The bolt should then be set carefully and expanded. Care should be used not to misplace them, and the holes should be filled with cement grout to increase the holding power and insure the exclusion of water. A sufficient time should be allowed for the hardening of the concrete, after which the bolt will hold, will not turn and will be ready for service.

Expansion Bolts Fill Many Requirements

By I. L. Simmons
Bridge Engineer, Chicago, Rock Island & Pacific, Chicago

Anchor bolts fall into two classes: Those which are placed in the masonry for the purpose of taking tension, or which may under certain conditions be compelled to resist uplift, and those which anchor a bridge or similar structure to prevent horizontal movement only. The first class includes the anchorage of columns, handrails, masts, etc.

In placing anchor bolts which may be compelled to resist tension, and which are not built into the masonry as it is constructed, I prefer to drill a hole slightly larger than the bolt, tapering it out a little toward the bottom, and fill the hole with either concrete or lead. If there will be considerable tension in the bolt, I would use a special bolt which is on the market which is fitted with a specially designed two-piece lead collar which can be easily and quickly expanded to fill the hole and hold the bolt firmly in place.

In anchoring bridges to masonry, the resistance is to horizontal movement only, so that the anchor bolts are required to resist shear only. I believe that it is sufficient in this case to drill the holes somewhat larger than the bolts and grout the bolts in at the proper location. This applies primarily to bolts of large diameter. If bolts of small diameter are required, the special bolt mentioned or some other satisfactory device which can be expanded is preferred.

Spray vs. Brush Painting

What is the relative durability of paint applied by brushing as compared with its application by spraying?

Spray Painting Shows Greater Durability

By E. C. Neville
Bridge and Building Master, Canadian National, Toronto, Ont.

The spray method of applying paint is of comparatively recent origin, so that the durability of the paint film applied by this method as compared with brushing probably has not been given sufficient study to make it safe for one to say dogmatically that one or the other of these methods gives superior results in this respect. From my own observations of paint applications made on identical surfaces by both of these methods, I am of the opinion that the paint applied by the spray gun has greater durability, while there is no doubt that it presents a better appearance.

Paint which has been sprayed onto a surface retains its gloss much longer than that applied by brushing. On close examination this is found to be due to the fact that the former has a smooth, even surface, while a rougher and somewhat ridged surface is left by the brush, which allows the dust to collect more readily on the surface.

In a specific test to gather information on these points, different surfaces, such as corrugated iron, steel plate girders and V-joints, tongue and grooved lumber were used, all of which had been painted previously. Considerable care was taken in the application of the paint, the surfaces were well cleaned and the same quantity of material was used for both methods. Observations were made at frequent intervals over a period of two years; at the end of this time it was found that the spray applications had a better appearance and seemed to have resisted weathering better than those that were made with brushes.

In applying paint with brushes it is obvious that the bristles leave slight ridges and grooves in the paint surface. In a poor job they may be plainly visible to the naked eye. Where the work has been more carefully done, they are not so obvious, and there is a tendency for the paint to flow and erase them. But even where the painting has been done by a skilled and careful workman and the striations are not easily detected by the eye, they will be disclosed by a low-powered magnifying glass. When viewed in this manner, the paint surface has a corrugated appearance and the uneven thickness of the film is apparent. Continued observations over the life of the paint will show that the thinner part of the film in the trough of the groove is always the first to perish.

When the spray method is used, the comparatively low air pressure that is required to operate the spray permits the operator to apply the paint in a finely and evenly atomized state. The quickly repeated sweeping motion over the surface, which an experienced workman invariably uses, enables him to

apply very thin layers of a uniform thickness which are free from blemishes. The rate of flow of the material can be adjusted to meet varying requirements, so that a skillful operator will cover a surface adequately with a minimum amount of paint. In this connection, it is fully as important that the quality of the paint be satisfactory as it is that it be applied properly.

Paint Sprayed on Has Greater Durability

By Master Painter

One of the frequent causes of paint failures is the tendency of the paint to scale after varying periods of weathering. This condition is often more aggravated in the southern sections of the country than it is farther north or in humid territory, as along the sea coast. In general, this trouble results from fundamental causes which do not include the method of application, if this has been done properly, but which may include the effects of moisture.

One of the principal causes of paint failure is the oxidation of the paint film or vehicle in which the pigment is carried. Under ordinary conditions, this process is a slow one and is generally called "weathering." Oxidation is accelerated, however, by the action of sunlight, principally by the ultra-violet rays, although it is likely that other actinic rays assist. The first and most direct result is a loss of elasticity, which is followed by checking and scaling and eventually a general failure of the entire film. Since the strength of these rays increases as the equator is approached, the life of the paint film is correspondingly decreased.

Wood fibre possesses the ability, varying with the species, of absorbing and holding moisture. When moisture is absorbed, the wood expands. When it dries out, it contracts. Practically all standard paints are sufficiently elastic when first applied to permit these changes to take place without causing any damage to the paint film. As oxidation progresses and the elasticity diminishes, a point is reached where the paint film is unable to respond and it is literally sheared off the wood. At this stage, the paint begins to crack or scale and becomes practically useless for protective purposes. The same action occurs with paint on iron and steel structures, but in this case, the expansion and contraction of the surface results from changes in the temperature of the metal. The effect on the paint is the same, however.

Moisture may cause similar failures in a different manner. In the North, an accumulation of moisture near the surface of the wood is not unusual. If this accumulation remains at the approach of cold weather, the freezing of the water may cause as much scaling as results from other causes. Other sources of trouble are bleeding of saps or resins and failure of the paint to adhere to knots.

There are several precautions that can be taken to minimize, if not overcome entirely, this trouble. In the first place, the vehicle should be of such a character that it will not allow moisture to pass through it. It should be resistant to the action of sunlight. The lighter colors possess this quality to a greater degree than the dark ones owing to their ability to reflect the light rays. Of fully as great importance is the proper priming of the surface, whether applied to the ordinary surface of wood, to knots, resin pockets, or to rough or smooth metal surfaces. It should have a high degree of elasticity, but should not remain soft, or the harder outer coat will be likely to check.

These causes of the failure of the paint film have been given because the method of application has a distinct bearing on the durability of the paint. No matter how skillful a painter may be, he is unable to apply the paint with a uniform thickness. This is because the brush, regardless of how much the paint may be "worked," leaves a corrugated surface composed of ridges and comparatively deep troughs. The thickness of the film is less in the troughs than on the ridges, and the life of the paint as a whole is no greater than the life of the thinner portions in the troughs. On the other hand, if the operator is equally skillful, the paint applied with the spray will have a uniform thickness and the oxidation will occur uniformly over the entire surface. The life of the paint, therefore, will be the same over the entire area and will not depend on the life at the thinnest places, so that it will be increased about in proportion to the uniformity with which the coat has been applied.

Furthermore, the density of the film of paint applied with the spray gun is somewhat greater than that applied by brushing so that, with the same material, the amount of moisture that will pass through it under normal conditions is decreased, and the detrimental effects of moisture are thus decreased and the life of the paint extended.

A further advantage of the paint applied by spraying is that the smooth, glossy surface does not catch and retain dirt, which in turn absorbs and holds moisture and thus accelerates the process of oxidation, as the rougher surface of the brush-applied paint does. It has been demonstrated repeatedly that the sprayed paint retains its glossy appearance much longer than the brushed paint, which is a clear indication of slower oxidation.

Safety with Track Jacks

What precautions can be taken in the use of track jacks to avoid creating unsafe conditions?

Eternal Vigilance Is Required

By Roadmaster

There are two principles upon which all safety work in track maintenance must be founded. The first is that no tool should be used for any other purposes than those for which it is designed; and the other is that tools that are worn enough to make them defective in any manner must not be used. The use of a jack with worn teeth, pawls, trunnions or lifting foot invites injury, sometimes of a serious character. Another practice that should never be permitted is that of tripping the jack when it is under load without making sure that all of the men who might be affected are in the clear.

Several disastrous wrecks have occurred through the practice, which is still common on some roads, of using the jack inside the rail. Some roads prohibit this under all circumstances. Others allow it to be done under flag protection. While it is sometimes more convenient to place the jack in this manner, necessity for doing so seldom arises. It has been my observation that foremen who do this occasionally, eventually do so more often, until it becomes a settled habit and the proper precautions are less and less observed. The best way is to prohibit the practice under all circumstances.

Using a lever that does not fit the socket, leaving the lever in the jack after completing its operation, pumping too fast to insure that the pawls are fully engaged, and trying to lift with the jack leaning from a vertical position are all fertile sources of potential or actual injury. Another practice equally bad is

that of using one jack where two or more should be used. Where this is done, a load is thrown on the jack that may be greatly in excess of its capacity, so that there is constant danger that it may fail or tip over at a critical moment. Furthermore, in order to make the lift, three or four men may be required on the lever, in which case the opportunity for injury is obvious.

The lever man should be required to work with his head and body well to one side or beyond the end of the lever. Otherwise he may be struck, if the lever flies up from any cause. Track work is sometimes carried on under considerable pressure. Under such conditions it is natural for the jack man to hurry from one position to another. He should never be permitted to do this when he is sliding the jack on the rail as he not only endangers himself but other men whom he must pass.

These may all seem to be simple matters and the necessity for the precautions which have been mentioned seem obvious. Yet the faulty practices continue in many quarters. The correction of these practices is almost always a matter of proper supervision and wherever they persist, it is a reflection on the efforts or management of the supervisory officers. It is only by constant attention to what might seem to be unimportant matters that unsafe practices can be eliminated.

Proper and Continued Supervision Is Required

By R. H. Gilkey
Division Engineer, Central of Georgia, Savannah, Ga.

While there are many details in the operation of track jacks which might result in injury to the operator himself or to the men working with him, in my experience one of the most fertile causes of such injuries is the failure to place the jacks opposite each other when making a lift. Another practice that should be prohibited is that of placing jacks inside the rail. As to the other practices, which I do not consider it necessary to mention in detail, accidents never happen—they result from definite causes. The only way to prevent them is for supervisors and foremen to be constantly alert, educating the men in the proper use of all tools and equipment and then insist that they use them in the manner which experience has indicated will eliminate personal injuries or the creation of hazards.

Latest Designs in Track Jacks Promote Safety

By M. D. Carothers
Assistant Engineer Maintenance of Way, Baltimore & Ohio Chicago Terminal, Chicago

The track jack is the most essential tool in track maintenance and the one that is used more often than any other. The design has been improved in recent years, until the latest types can be operated with a minimum hazard of personal injury, provided they are handled properly. For example, most roads prohibit the use of jacks inside the rail, except when necessary, and then only under adequate flag protection.

However it may be used, the jack must be removed quickly as a train approaches. For this reason, the jack should always be in first-class condition and should be set so that there will will be no delay in removing it. For this purpose the single-acting jack is superior and is safer, since the load can be released by striking the lever socket, as compared with the double-acting jack in which it is necessary to use a jack lever and engage a trip. Furthermore, the single-acting jack is safer to operate than the double-acting jack, since the load is raised as the lever is lifted and the lever is lowered light for the next pull. This type of jack practically eliminates injuries to heads, arms and shoulders.

The design has also been improved by employing a square socket in which a lining bar can be used as a lever, instead of the oval socket for a wooden lever. This is on the side of safety, since, if the wooden lever is lost or broken, trackmen have a habit of using a lining bar as the lever and placing a spike in the socket to take up the play. This is dangerous, because, if the pawls do not engage and the load drops as the lever is being changed, the man operating the jack is almost certain to be injured.

Wood Wearing Surfaces

What is the most satisfactory design for a wooden floor on an overhead highway bridge carrying heavy automobile traffic?

Top Plank Should Be Laid Lengthwise

By Engineer of Bridges

Where it becomes desirable to maintain a wooden wearing surface on an overhead highway bridge, a double floor should be laid, the bottom course being placed at right angles to the axis of the bridge and upon this the wearing surface should be laid longitudinally with the traffic. The reason for this is that, even with rubber-tired vehicles, wood planks laid transversely will wear to an uneven surface in a comparatively short time. Since the route followed by the wheels is generally confined to a relatively narrow zone, it becomes unnecessary to replace the entire wearing surface when renewal becomes necessary if the planks are laid longitudinally, while if the wearing surface is laid transversely, the entire floor must be renewed, even though the actual wear occurs within the narrow limits occupied by the moving traffic. For this reason the longitudinal method of placing the planks will reduce the cost of maintenance and, so far as I have observed, will give a smoother and more satisfactory surface for the movement of the vehicles than if they were laid at right angles to the traffic.

Wood Blocks Are Most Satisfactory

By Supervisor Bridges and Buildings

Wooden planks do not provide a satisfactory wearing surface where heavy traffic must be carried. This statement is exemplified by the many efforts that are being made throughout the country to find a satisfactory substitute for the wooden plank highway crossing.

The statement that a plank wearing surface on overhead highway bridges is not satisfactory for important highways holds true whether the planks are laid at right angles to or longitudinally with the traffic. If they are laid transversely, they shrink, warp and get loose so that they rattle under the moving vehicles, creating the impression that the bridge is unsafe. In addition, they wear quickly, so that the floor becomes rough and uneven. When this stage is reached, it is necessary to renew the entire floor, even though the total wear of the individual planks is nearly negligible.

If they are laid longitudinally, it is not necessary to renew the entire floor except at long intervals. In this case, the actual wear on the planks is less pro-

nounced and the wearing surface is likely to remain smoother for a longer time. The tendency of the planks to warp and get loose is little different, however, and in this case a warped end is almost certain to stick up above the general surface and thus introduce a definite danger to vehicles.

It has been my experience that where it is considered necessary or desirable to maintain a wooden floor on an overhead highway bridge the wood-block type gives the most satisfactory results. It has the advantage of comparatively light weight, smooth surface, good traction, minimum wear and ease of replacement. It also has the same characteristic as longitudinal planks with respect to renewing the worn surface, in that only the worn blocks need to be replaced. If the blocks are properly laid in the first instance, they probably will require less maintenance than any other comparable type of wearing surface. Since they will also outlast many applications of plank, these features will, in part, offset their higher first cost.

Checking Meter Readings

What methods should be followed to check meter readings of water that is purchased?

Joint Readings Should Be Required

By R. H. Gilkey
Division Engineer, Central of Georgia, Savannah, Ga.

It is our custom to require that all meter readings for water furnished from outside sources be made jointly by representatives of the water company and of our local water service department. In some cases, at remote points, one of the division pump repairmen is assigned to act as the representative of the railway. At other points, we have a plumber who is familiar with meter operation and meter reading, who acts in this capacity. We never accept a bill for water consumption which is not based on a joint reading and which has not been approved by the representative of the railway who checked the reading.

Readings Should Be Checked and Recorded

By C. R. Knowles
Superintendent Water Service, Illinois Central, Chicago

Water meters are read by representatives of the company furnishing the water. The railway should insist that this be done in the presence of a representative of the water service department who should be required not only to check the reading for accuracy, but to make a record of the reading for immediate comparison with previous readings.

If this reading shows an increased consumption which cannot be explained satisfactorily, a survey should be made to determine possible leaks. In the event that leaks cannot be detected and no legitimate reason for the increase is found, the meter should be tested either by means of a supplementary test meter or by removing it from the line to be sent to the laboratory for test.

A complete record of all meter readings should be kept for purposes of comparison, which should be on file in the division offices, so that discrepancies may be detected immediately after the meter is read. In the event that the meter fails, bills should be prepared on the basis of previous consumption over a sufficient period to represent average conditions. A graphic chart which is always kept up to date and which covers a period of several years will be found quite helpful in detecting irregularities in meter readings.

As a rule, meters are maintained by the water company, regardless of the ownership of the meter. In the interest of accuracy and in justice to both producer and consumer, meters should be maintained in good condition at all times. Furthermore, to minimize the probability of incorrect readings, meters should always be readily accessible, and meter pits should be drained and kept in a clean condition.

So far as practicable a railway should standardize its water meters, so that those employees whose duties require them to read, test or repair them may be familiar with their operation and their mechanical construction. This will enable them to test and maintain them at their highest efficiency and at a minimum cost.

Intertrack Ballast Shoulder

What is the best form of ballast shoulder for the intertrack space on multiple track lines: a level section from end of tie to end of tie, a slightly dipped section, or a V-section with definite toe lines?

V-Sections Reduce Trouble from Heaving

By J. J. Hess
General Roadmaster, Great Northern, Seattle, Wash.

An opportunity was given me several years ago to observe closely the result of frost action on the track of a railway in the northern section of the country where the ballast in the intertrack space has been brought even with the tops of the ties. I was also able to compare the conditions on this track with those on another section of track which was exposed to practically similar conditions, but where the ballast had been given a V-section with definite toe lines.

In both cases, late rains occurred shortly before the ground was frozen, and because of their duration and the amount of precipitation, the run-off was not completed before freezing weather set in. Where the full section of ballast was installed between tracks, the heaving was extensive, the track became exceedingly rough and an unreasonable amount of shimming was necessary. On the other hand, while shimming was necessary on the other section of track, the amount was moderate in comparison, and the riding qualities of the track were far better.

Later experience has confirmed me in the belief that a deep U-section or, still better, a V-section with definite toe lines will give the most satisfactory results from all points of view, particularly where there is a tendency for the track to heave. The maintenance of the toe lines may involve some expense, but this is not enough to offset the benefits derived from this practice, especially in sections of the country where the frost penetrates deeply.

The V-Section Has Proved Most Satisfactory

By M. M. Backus
Assistant Engineer Maintenance of Way, Illinois Central, Chicago

At one time the railway with which I am connected used a ballast section which varied from one that was level from tie to tie to one that was slightly dipped. During this time, we experienced considerable difficulty with drainage, particularly in that part of the ballast between the tracks. While the ballast was fresh and clean, the water was able ultimately to seep through to an outlet, although this

was generally a slow process at best. After it had been in place for a comparatively short period, however, even the unsatisfactory drainage which was at first provided became less effective, owing to the fouling of the ballast, and finally no drainage at all was provided for the intertrack space. This made it necessary to clean the ballast periodically and, since the cleaning was a hand operation, the cost was high.

At that time the outside ballast shoulder was considerably wider than the present standard. It was the general belief of the maintenance men on the road that these heavy shoulders were necessary to hold the track in line. Some improvement in the drainage was necessary, however, and after careful consideration a V-section was adopted for the intertrack space, which, because of the wide track centers, permitted each track to be treated as an independent unit. At the same time the width of the shoulders was reduced and a distinct toe line was required, not only on the outside ballast shoulder, but also for each track in the intertrack space.

Better drainage resulted immediately, with a noticeable improvement in track conditions. Churning ties were practically eliminated and there was no adverse effect on the line, while less work was required to keep the track in line and surface. The new standard required from 600 to 800 cu. yd. less ballast to the mile, depending on whether the tracks were on 14-ft. or 15-ft. centers. So beneficial were the results that the installation of this new standard progressed as rapidly as was practicable. This progress was determined by the desirability of cleaning the ballast and giving the tracks a general lift. Entire districts were surfaced in this manner, requiring only an occasional car of ballast, which was used where the existing ballast section was considerably below the old standard.

Does Not Favor a V-Section

By Office Engineer

Sharp difference of opinion exists as to the best form of ballast shoulder for the intertrack space on multiple-track lines. This difference may be the result of different conditions under which maintenance officers on the various roads are working. On some of the western roads where the track centers are wide it is obvious that the V-section will be favored. Where the track centers are close, as on most of the eastern roads, the opposite viewpoint is assumed.

In my own opinion, as the result of wide observation, the slightly dipped section seems to be most advantageous. Exponents of the V-section point to the saving in ballast, which amounts to 400 cu. yd. to 800 cu. yd. per mile, depending on the track centers and the depth of the ballast, and the reduced amount of ballast cleaning which becomes necessary. This saving may be more than offset, however, by the cost of dressing the ballast. Furthermore, the V-section leaves the track forces without a reserve supply of ballast for light surfacing which must be done from time to time. Another disadvantage is that this section affords poor footing for the trainmen, so that under no circumstances should it be used near interlockings or around stations or other points where switching is done.

The value of this section from the standpoint of drainage and ballast cleaning is disputable. It is logical that the thin layer of ballast necessary for the V-section will foul more quickly than the thicker layer of a full or dipped section, which tends to hold the dirt at the top and allow the deeper ballast to act as a French drain. The argument of less ballast cleaning carries little weight in view of the facility with which modern machines do this work.

The level section is advisable where it is necessary for employees to walk between tracks, but elsewhere it appears to involve a needless expense for ballast that does no work. In all other locations, my judgment is that the slightly-dipped section, with about six inches of ballast in the trough, is the most practical and economical for general use. It provides adequate drainage, affords a reserve for light surfacing, is readily shaped up and easily maintained, does not involve hazards to employees in walking and does not interfere with economical ballast cleaning.

Lateral Drains in Cuts

A further answer to the following question which was discussed in the September issue.

Where lateral drains are laid under the track in wet cuts, how far apart should they be placed? Should they all drain to the same side of the cut or should the alternate laterals drain to opposite sides?

Alternate Laterals Should Drain to Opposite Sides

By Roadmaster

In draining wet cuts to cure or prevent the formation of soft spots, the most important consideration is that of disposing of all of the subsurface water as quickly and effectively as possible. Tile drains will draw ground water from considerable distances, but beyond a zone 15 ft. to 25 ft. wide on either side, depending on the character of the soil, this process is slow. The evidence of this is seen in the fact that such drains often continue to discharge considerable quantities of water during prolonged dry periods.

For this reason, it is necessary to place lateral drains in wet cuts at close intervals in order to insure quick disposition of the water. This becomes of greater importance if the material to be drained is a heavy clay which gives up its water slowly. Tiling wet cuts is usually somewhat expensive, as compared to ordinary tile drainage, and the plan followed should be developed to obtain the maximum benefit from the expenditure. My own experience leads to the opinion that such benefit cannot be expected unless a maximum of two laterals are installed to the rail panel. Many times, however, particularly if soft spots have already developed, double this number is indicated. The severity of the trouble and the character of the soil to be drained are the determining factors.

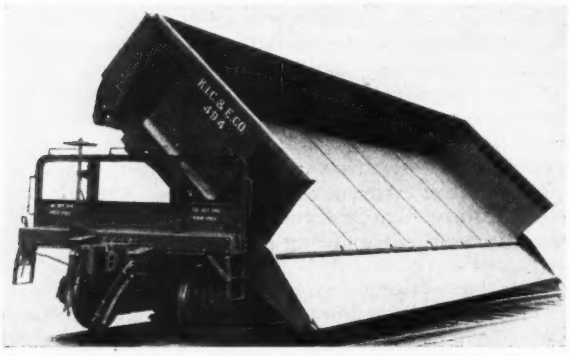
It has already been mentioned that quick and effective removal of all of the water is the fundamental purpose in designing drainage for wet cuts. For this reason, tile should be laid on both sides of the cut, not only to drain the roadbed completely, but also to intercept any seepage from the sides of the cut. The draining of alternate laterals toward opposite sides of the track assists in making this drainage more complete and more quickly effective. By placing the alternate laterals in this manner, it is often unnecessary to lay the mains as deep as would otherwise be required. Furthermore, it is apparent that, if the area of the soft spots extends beyond the limits of the ballast, the drainage is easier and more certain to be accomplished than if the laterals all extend in one direction.

NEW AND IMPROVED DEVICES

Koppel Builds 50-Yd. Dump Cars

THE KOPPEL Industrial Car & Equipment Company, Koppel, Pa., a subsidiary of the Pressed Steel Car Company, has developed and placed on the market a new large capacity, automatic air dump car which is designed to meet a wider range of usefulness and produce greater economies of operation than are possible with the dump cars of smaller capacity that are generally in service at the present time. This new car has a level capacity of 50 cu. yd., an average heaped capacity of 65 cu. yd., and a load carrying capacity of 70 tons.

In practically all respects the new car incorporates the fundamental features of design and construction of



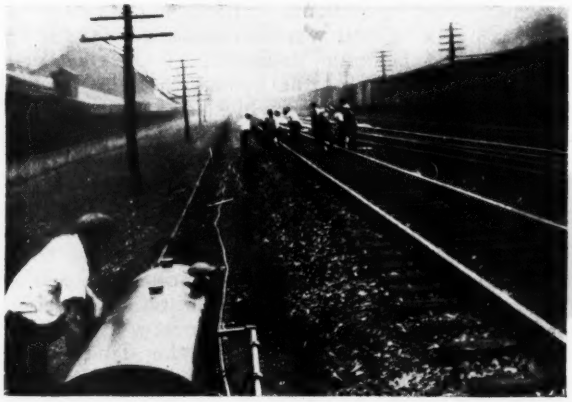
The New Car in Full Dumping Position, Showing Lowered Side Door and Shed Plates

the later types of Koppel cars of smaller capacity, elaborated upon where necessary or advisable to meet the increased service requirements of the larger equipment. These fundamentals include the rolling trunnion principle of dumping, which, it is said, acts to give extra power to the dumping cylinders at the moment of starting the body from rest to the dump position; low center of gravity to insure stability of the car on the track in transit and when dumping; support for the body on the underframe and not on the trunnions; rapid discharge of loads without excessive shock to the car or the track; doors of heavy box-girder construction and equipped with shed plates to prevent dirt from gathering and causing the doors to jam; simple and positive door operation with the operating gear so arranged that the door may be stopped at any point in its movement from normal upright to full dump position without damage to the door, the gear, or the car; positive locking of the body and doors in upright position for movement of the car in work-train or revenue service; easy and quick dumping and reversal of the dumping direction without the necessity of the operator going between cars; and suitable connections whereby the cars may be dumped in multiple as well as singly, either from any car in the train or from the locomotive. The new cars are equipped with an air storage tank of suitable capacity to make prompt dumping independent of the air capacity provided by the locomotive.

Following are the more important dimensions, the dumping angle and the weight of the new 50-yd. car: Height overall, 8 ft. 7 5-16 in.; width overall, 10 ft. 4½ in.; length over striking plates, 46 ft.; length inside body at top, 42 ft. 2½ in.; length inside body at bottom, 40 ft. 5 in.; width inside of body at top, 9 ft. 3 in.; width inside of body at bottom, 8 ft. 10½ in.; depth inside body, 3 ft. 7 in.; coupler height, 2 ft. 10½ in.; center to center of trucks, 35 ft. 9 in.; truck wheel base, 5 ft. 6 in.; dumping angle, 45 deg.; and weight, 80,300 lb. The new Koppel car meets all A. R. A. and I. C. C. requirements and is, therefore, accepted for movement in interchange service.

Syntron Finds Two-Cable System Better

THE SYNTRON Company, Pittsburgh, Pa., has adopted the system of carrying electricity from portable power plants to its electric tie tampers by means of two cables, thereby displacing the one-cable system which was formerly used. It is believed that the new system has a distinct advantage over the old system, in that the time lost when clearing trains is materially reduced. When only one cable is used, it is necessary for the tie tamper operators who are working on the far side of the track to carry their tampers to the opposite side when clearing the track for passing trains. The new arrangement provides for two cables emanating from the power plant, one passing down the side of the track on which the power plant is located, while the other passes under the track near the power plant and thence down the opposite side to the location of the work. With this arrangement, the operators clear



A View of a Tie-Tamping Outfit Equipped with Two Conductor Cables

approaching trains by simply leaving their tools on the side of the track that they happen to be working on. Each of the two cables used supplies power for two to four tampers, depending on the size of the outfit.

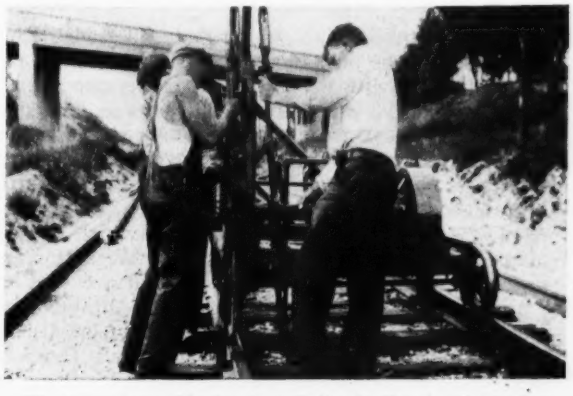
Gasoline Spike Puller Developed by Nordberg

A POWER-OPERATED device for pulling spikes, known as the Nordberg mechanical spike puller, has been added to the list of power track tools which are manufactured by the Nordberg Manufacturing Company, Milwaukee, Wis. This device consists of a four-wheel welded steel frame carrying two pair of spike tongs which receive power from a 2½-hp. gasoline engine through a system of levers and gears. The engine is situated at one end of the frame and is belted to a heavy flywheel at the other end, which carries a small pinion driving a large gear. This part of the mechanism is situated on the side of the frame opposite to the pulling apparatus. The large gear is fixed to a shaft which carries a crank and a vertical connecting rod at its opposite end. This connecting rod actuates a long horizontal lever which is pivoted about the top of a vertical post at the other end of the frame.

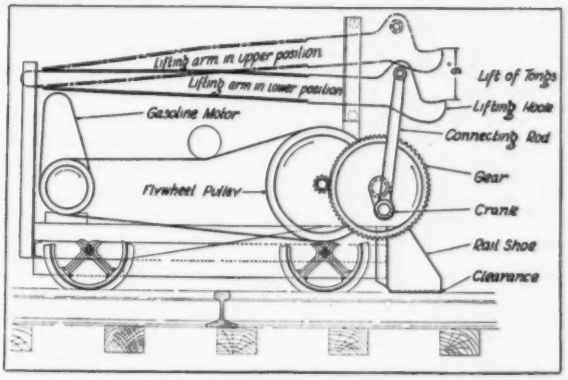
The lever is equipped with a hook at its free end, which has a vertical movement of nine inches and which engages the spike tongs and applies the power when spikes are being pulled. Two spike tongs are furnished for pulling spikes alternately on opposite sides of the rail. They are suspended directly over the end of the lifting arm or lever by springs and chains which are hung from an inclined member which is firmly attached to the frame.

In order to relieve the wheels and axles of all load other than the weight of the machine, a steel shoe is provided which is designed to absorb the force of the pull by transmitting it to the rail. This shoe is welded to the frame of the machine at the corner where the pulling takes place. Normally, it is held in a raised position about ¼ in. above the rail, but when a spike is being pulled the downward force causes the springs which hold the shoe from the rail to compress, thus allowing the shoe to bear on the rail. The shoe automatically returns to the raised position when the pull is removed.

The pull exerted on the spike is said to be directly upward and, consequently, there is no tendency to distort or bend it. The design of the tongs is such that the gripping action of the tongs increases with the force required to pull the spike. It is claimed that the machine is designed for and capable of exerting a pull of 10,000 lb. and that the pulling capacity is sufficient



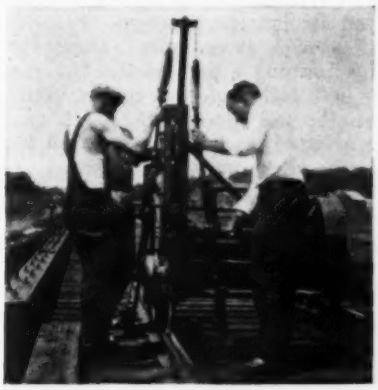
The Nordberg Mechanical Spike Puller in Operation



Showing the Essential Working Parts of the Spike Puller

to remove spikes from solid oak ties, without their first being started by a blow from a spike maul. It is claimed for this machine that it will pull any spike which protrudes far enough to be gripped by the tongs.

The machine is equipped with a crank-and-chain drive at the side, with which it is moved from tie to tie, to spot the puller. As soon as the machine has been stopped after being spotted over a tie, one of the three operators slips the tong jaws over the spike head and moves the top of the tongs over so that the hook



The Spike Puller Is Particularly Efficient and Safe for Operation on Bridges

on the end of the lifting arm engages a lug on the tongs. Then as the hook moves upward the spike is pulled. While the operator on the inside is pulling a spike, the other man grasps the outside spike and as soon as the hook is released the lifting process is repeated with the other tongs. The tongs are opened by a slight downward pressure to overcome the force of the spring directly above the handle. As soon as the spike is free from the tie, the tongs open automatically and drop the released spike to the ground.

In ordinary service, with one man moving the machine and two men at the tongs, it is claimed that this spike puller will maintain a speed of 20 to 25 spikes a minute and that on bridges, or where double spiking is used, two men have pulled spikes at the rate of 36 a minute. Two men are said to be sufficient to turn the machine to pull spikes on the opposite rail, or to lift it for the insertion of run-off rails for setting off the track. A jack screw is attached to the machine at its approximate balancing point. The gear, pinion, crank and connecting rod of the machine are enclosed in sheet metal safety guards.

This new spike puller is particularly suited to use on

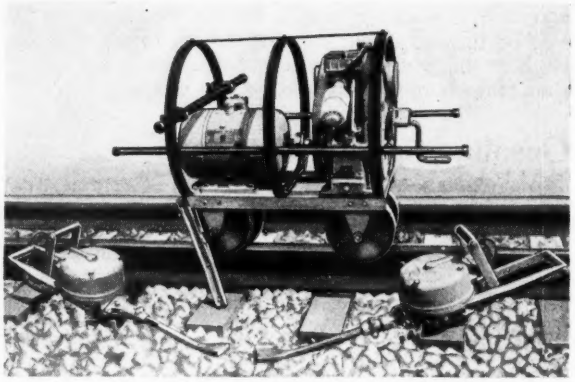
open-deck bridges where the footing for men using claw bars is necessarily precarious, and where the work of pulling spikes is ordinarily difficult and time-consuming. The device is especially efficient when pulling spikes on the outside of the rails as the presence of the guard rail, coupled with the lack of adequate footing there is particularly detrimental to the efficient and safe operation of claw bars. The same advantages which attend the operation of the spike puller on bridges also apply to pulling spikes at switches and frogs where the operation must of necessity be accomplished among crowded conditions.

A New Light-Weight Power Unit

WITH the objective of supplying equipment that will give the standard size track gang the benefit of mechanical methods in track work, the Electric Tamper & Equipment Co., Chicago, has developed a light-weight power plant, designated as Model H-2, which is designed particularly to furnish power for this company's universal and hammer-blow tie tampers. The power plant consists of an air-cooled gasoline engine direct-connected to a generator supplying 110-volt, 3-phase, 60-cycle current and having a capacity of 1 kv.-a., which is sufficient power to operate two electric tie tampers.

The power plant is carried in a frame which is mounted on two double-flange wheels in tandem, which are designed so that the plant may be moved on any flat surface as well as on rails. Three rigid circular metal hoops forming a part of the frame enclose the generating unit and protect it in the event that it is rolled from the rail to clear the track quickly. The equipment is lifted to and from the rail by means of two tubular handles, one being fastened to the hoops on each side. In addition, another handle, which is attached to the rear hoop at right angles to the track, is provided for use in pushing the unit along the rail, and may be extended in either direction for that purpose. When in use, this equipment is held in an upright position on the rail by means of a brace which is pivoted at the end of the frame so that it may be turned upward during the movement of the unit and lowered to bear on a tie when the unit is stationary.

One Man Is Sufficient to Move the New Unit

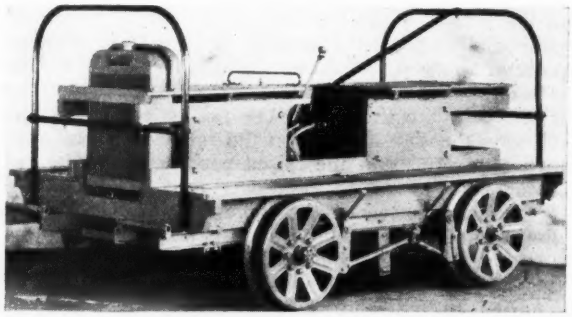


Side View of the Light-Weight Unit

This equipment weighs 375 lb. and two men are sufficient to lift it to and from the track, while one man can roll it along the track with ease. Conductor cable is furnished in 250-ft. lengths which permits a working radius of 500 ft. without moving the machine. Other standard electric tools, such as grinders, drills and saws, may be operated in conjunction with this power unit.

Fairmont Develops Large Extra-Gang Motor Car

A NEW extra-gang motor car which is especially suitable for pulling light ballast discers has recently been developed by Fairmont Railway Motors, Fairmont, Minn., and is designated as the A6 large extra-gang car. The 40-hp. engine, with which the car is powered, is the standard Model "A" engine used in the new Ford cars and trucks; the car is also equipped with the Ford "AA" four-speed truck transmission. All parts are said to be standard size and most of them are carried in stock and are immediately obtainable from authorized Ford dealers. The car is equipped with an extra-large radiator to prevent the engine from becoming overheated.



The New Fairmont A6 Large Extra-Gang Motor Car

A new development is the "cockpit" which is provided for the driver and all controls. With this arrangement, safety and speed of control are said to be materially increased as the clutch, brake, foot throttle, gear shift and emergency brake levers are all identical in arrangement and operation with those in standard automobiles and trucks.

Another safety feature is the hinged wood cover

which is provided for each of the 92-in. by 11½-in. by 8-in. tool trays. Besides providing a safe footing, this covering permits the seating capacity to be increased from 11 to 23 men by the addition of side steps similar to those used on passenger trailers. Rail skids and extension handles are also features of the new car.

The car is designed for quick access to all working parts with a minimum of effort, thus securing speed in operation, servicing and maintenance. It has an all-gear and propeller shaft drive which is said to be similar to that used in 95 per cent of the trucks and all automobiles made in 1929. The gears are hardened cut steel and all four speeds are equipped with ball or roller bearings throughout, being fully enclosed and running in transmission oil. Four speeds either way eliminate the necessity for turning the car on the track for fast return trips. This saves much time in clearing trains when discing, and is accomplished by shifting a lever that reverses the Fairmont rear axle gear.

The A6 car is designed particularly for use in connection with the Fairmont M25 discing equipment, although the discs may be removed in five minutes, leaving the car ready for other heavy duty or large extra gang service. An electric starter, generator and battery are standard equipment and lights can be furnished.

Two New Electric Switch Heaters

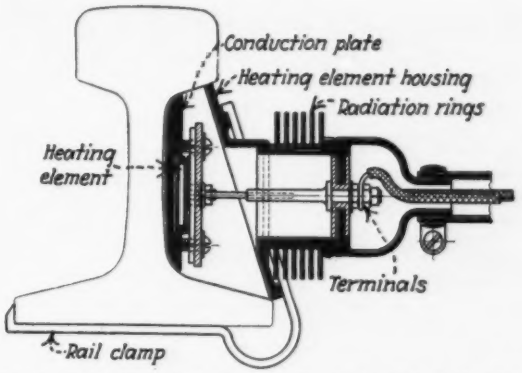
TWO NEW designs of electric switch heaters, one of which is distinctly new in type, have been put on the market by the Ruby Railway Equipment Company, Philadelphia, Pa. These two heaters, which have been given severe service tests, are known as the Improved Keim contact electric switch heater and the G. & R. electric radiation switch heater.

The first mentioned of these heaters applies the heat from a 500-watt element, directly to the outside of the web of the stock rails, thereby making these rails the carriers and disseminators of the heat. On the closed side of the switch the point also acts as a carrier and disseminator of the heat because of its direct contact with the stock rail.

The Keim heater is designed for use in multiple on a switch, from 14 to 26 units being required for a switch layout, depending upon the length of the points. The units themselves consists essentially of a Monel-metal-covered heating element in close contact with a metal conduction plate, which, in turn, fits accurately the web and fishing areas of the rail; a metal housing which entirely incloses the heating element and conduction plate to confine the heat and direct it against the rail; two terminal posts inclosed in a housing provided with radiation plates to keep the terminals and lead wires cool; and a weather-tight metal protection cap directly over the terminals.

The separate parts of the heater are assembled in a compact unit which is held securely against the side of the rail by means of two heavy flat springs. These springs, which snap into place readily at any point along the back of the heater to prevent their interference with parts of the switch equipment, extend under the base of the rail and hook over the inside flange. The upper parts of the springs extend up over the back of the heating element housing to a hook connection with a ridge along the top of the housing, these parts of the straps forcing the heater into tight rigid contact with the rail.

This latter feature of the heater, together with the



Sectional View of the Keim Contact Switch Heater

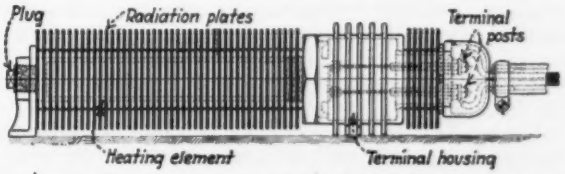
sturdy construction of the unit itself, including the heating element, which is inclosed in a Monel-metal cover with brazed seams, constitute important mechanical features of the new heater. Extensive tests, which have been continued through the summer months, have shown that the heater is not affected adversely by weather conditions or by the severe vibration to which it is subjected.

The heaters, which have an over-all length of 12½ in. along the rail, are located between ties throughout the length of the switch points. They can be operated by either direct or alternating current at 110 volts from a third-rail circuit or commercial power lines, and can be connected in series or parallel as the power supply may require.

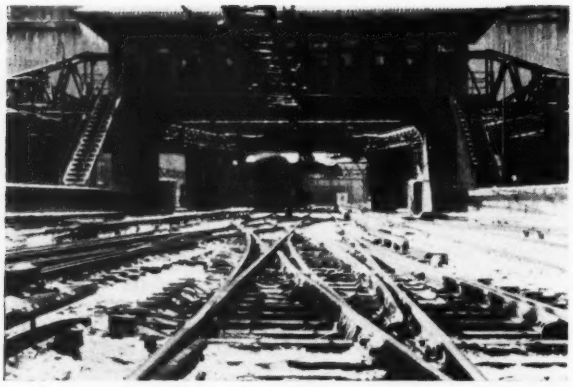
Tests made of the heaters in service show that they are capable of raising the temperature of the rail at the center of the heater 15 deg. in the first 15 min. of operation, 65 deg. in 45 min. of operation, 75 deg. in one hour of operation and about 120 deg. in two hours' operation. This performance has been found to hold practically true regardless of the temperature of the rail or the atmosphere at the time the heat is first applied. Heating of the rail by the individual heaters diminishes with the distance from the heaters, but as the heat from each heater overlaps that of the next adjacent heaters, a fairly uniform temperature is maintained throughout the full length of the installation.

Recognizing that there exists a place for the ballast-type heater, under the center points of slip switches, in switch installations where detector bars are used and where for any reason the Keim heater cannot be fastened to the rail, the Ruby Company has also developed an effective heater of the radiation type. This heater, known as the G. & R. radiation heater, is cylindrical in shape and is equipped with a large number of radiation rings or fins which have a total radiation surface of approximately six square feet. Its heating element is of 1,000-watt capacity and is of special design and construction so that it will withstand vibration and will not be affected by moisture, even when submerged in slush and water.

The G. & R. heater is designed to be placed be-



Longitudinal View of the G. & R. Electric Radiation Switch Heater



A Switch in a Busy Passenger Terminal Equipped with the Keim Switch Heaters

tween the ties on the ballast directly under and at right angles to the switch and stock rails. It may also be placed directly under lock and operating rods or other moving parts of equipment in the track, such as car retarders. In addition to heating the ballast and thereby stimulating drainage, it is said that the rail directly above the heater absorbs and transmits a considerable amount of heat which is effective in melting snow and ice about the switch points.

Like the Keim heaters, the G. & R. heaters can be operated on either alternating or direct current, in series or in parallel, from either third-rail circuits or commercial power lines.

An Asphalt-Base Aluminum Coating

THE HEADLEY Emulsified Products Company, Philadelphia, Pa., has put on the market an asphalt-base aluminum coating material which has wide application in the railway field, and which is said to combine the advantageous qualities of its two constituents, high-grade asphalt and metallic aluminum. This new coating composition is equally effective for application over concrete, wood, fabric, steel, iron and other metals for the prevention of corrosion and disintegration caused by the action of moisture, acids, alkalies, chemical fumes, salt-laden air and other destructive agencies. The new product is said to be easy of application and to provide maximum protection at minimum cost.

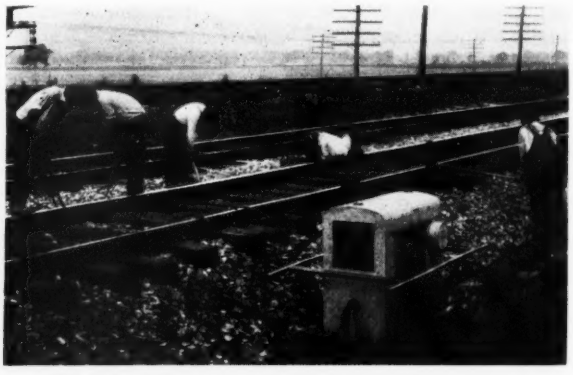
The ingredients are aluminum flake and pure refined Mexican asphalt with only enough volatile solvent to produce a product of good brushing or spraying consistency. Upon application, the solvent evaporates, leaving a uniform continuous deposit of asphalt, covered with a uniform armor coat of metallic aluminum. The quantity of aluminum in the product is said to be amply sufficient to cover the asphalt thoroughly and to insure maximum durability.

The aluminum used is prepared by a stamping process which forms minute flat flakes instead of the granules obtained ordinarily by grinding. In the finished operation of applying the coating, the flakes are given a lustrous surface by polishing, which is said to reflect over 70 per cent of the light rays which fall upon it.

The product is suited equally for either a finished coating or a primer under tinted oil paint. It is said that the opacity and imperviousnes of both the asphalt and the aluminum prevent the bleeding through of stains and color spots of underlying coats, and that a single coat will cover a dark base, even if black, to a uniform light tint. It is also said that the light tint surface produced by the product as a primer permits one top coat of light or medium tinted oil paint to cover as completely as two coats of such paint over an oil primer.

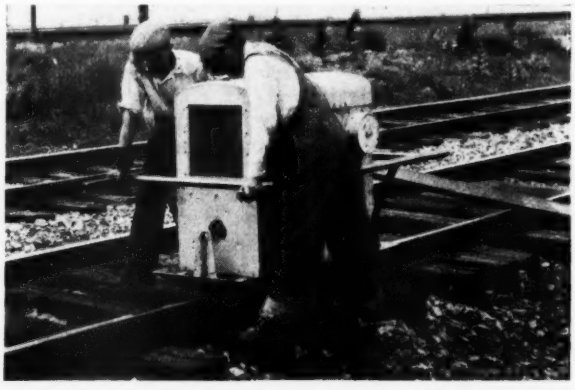
Portable Air Compressor Facilitates Spot Tamping

WITH THE object of supplying a portable air compressor unit for operating pneumatic tie tampers when spot-surfacing track with a small force, the Ingersoll-Rand Company, New York, is now offering a gasoline-operated unit with sufficient capacity to operate two of its pneumatic tie tampers and which can be used to power other air-operated equipment such as spike pullers, spike drivers or rail drills. The new unit, which is known as the "spottamper," consists of a two-cylinder air compressor powered with a two-cylinder gasoline engine. The operating mechanism is entirely enclosed in a metal housing and tubular handles are provided for use in handling the equipment. The unit is mounted in a steel pan which is equipped with rollers for use in moving the equipment along the rail and which are also designed to roll on any flat surface so that the unit may be moved to and from the rail by means of planks.



When in Operation the Spot-Tamper Is Removed from the Rail and Placed on Planks Along Side of the Track

This compressor is 6 ft. 4 in. long, 3 ft. 3¾ in. wide and 4 ft. 6 in. high and is said to be handled easily by a spot-tamping gang. One road reports that four men in



The Unit Is Moved from One Location to Another by Means of Rollers

addition to the foreman are sufficient to handle this unit and that, with this organization, one mile of track was covered in five days, with an average of 208 ties tamped inside and out and with an average of 52 joints and low spots raised daily. This road also reports that the machine consumes an average of one gallon of gasoline an hour and that, by means of planks, it can be removed from the track in 45 seconds.

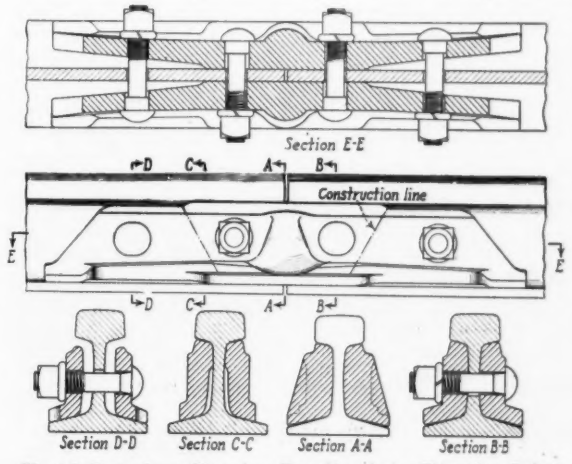
Many Features Claimed for New Type Rail Joint

AFTER a number of years of study, development and tests, the Muller rail joint, now known as the Evertite rail joint, is being manufactured and distributed by Standard Equipments, Inc., New York City. This new type of joint employs two joint bars and four bolts with lock washers like many types joints now in use, but differs from the usual type of joint construction primarily in the design of the bars.

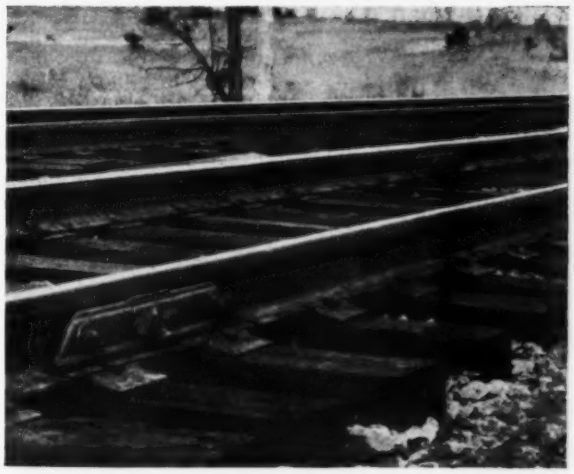
Evertite bars are designed with a thick middle portion of pillow-block construction, which fits snugly against the side of the rail, with flared ends which have contact only on the upper face of the rail flange as the bars are drawn tightly into position. The thick middle portion of the bar, which varies from 10 in. to 11 in. in length, depending upon the section and weight of the rail for which the bar is designed, is reinforced by a heavy vertical rib which widens out toward the base of the bar where it joins a horizontal reinforcing rib along the bottom edge of the bar. From the middle thickened portion, the section of the bar diminishes gradually in height and thickness out to each end.

The center portion of the bar is made to fit closely the contour of the rail, under the head, down the web and over the bottom flange, extending for a distance of from 5 in. to 5½ in. back from the ends of the rails at a joint and including the two center bolt holes. When the joint bars are applied to the rail, therefore, the middle portions of the bars are drawn to a tight fit against the rail by the two center bolts. Another feature of the pillow-block section of the joint bars is that the back side of the thick end portion has a greater length of bar along the top of the rail web than along the bottom, as is indicated by the construction lines in the accompanying sketch of the joint. It is contended that this feature gives the joint bars a dove-tail or wedge seat against the sides of the rail web and thus prevents the bars from being forced downward under wheel loads.

The bottom edge of the joint bar throughout its length is designed to rest on the flange of the rail base, but the wing ends of the bar have clearance from the web and under side of the rail head. Each wing contains a bolt hole so that when the bars are applied to the rail the wings of opposite bars are drawn inward toward the rail web. In this operation, the lower edges of the wing portions slide upward on the rail base, thereby tending to raise the ends of the rails at the joint.



Sketch Drawings Showing Details of the Evertite Joint



Evertite Joints on a Section of Heavy-Duty Track

Drawing in the ends of the bars also forces the center portions of the bars inward and upward against the rail and holds them there under the high spring tension set up in the bars. This spring tension in the bars gives the joints a reflex spring action under wheel loads, which, it is said, causes the flexure of the two rails within the limits of the joint to approximate that occurring elsewhere throughout their length.

Evertite bars are made of high-quality, drop-forged steel with heavy die blocks set in five-ton to eight-ton steel hammers. After drop forging, the bars are set in a trimming die where they are cut and trimmed of all flash or overflow metal; they are then tumbled in a large revolving steel cylinder to remove all sharp corners or rough edges. The bars are inspected and drilled, and then heat-treated to produce a Brinnell hardness of 250 to 300.

Among the advantages claimed for the Evertite bars, are the following: They can be applied to either new or old rails without change in the existing track structure; they allow for proper expansion and contraction and keep the rail ends straight, both horizontally and laterally; they produce smooth riding and safe track and minimize the noise of wheels at the joints; and they are sufficiently lighter in weight than present styles of bars to effect a saving of from 2 tons to 10 tons of steel per mile of track.

Other claims made for the Evertite joint are that it reduces the amount of batter and minimizes joint maintenance, including both tamping and bolt tightening; and that it reduces by 25 per cent or more the sectional area of bonds necessary at joints in electrified or automatic signal territory.

Evertite bars are being manufactured for all of the more common sections and weights of rail, including head-free rail, and for compromise and insulated joints as well as ordinary joints. At the present time these bars are being tested by a number of roads on important heavy-traffic tracks, and it is said that favorable results are being reported generally. The oldest of these tests has been in service since the summer of 1928.

One-Man Tool Bevels Rail Ends

A ONE-MAN, hand-operated portable tool for beveling the ends of newly-laid rail has been developed and is being offered to the railways on a rental basis by the Electric Railweld Sales Corporation, Chicago. This tool serves the same purpose as this company's power-operated grinder which was described in the June issue of *Railway Engineering and Maintenance*, namely that of removing the overhang and beveling the ends of newly-laid rail after cold rolling of the rail has occurred, to prevent chipping of the rail ends.

The essential parts of the tool consist of a double-ended shaper bit for making the bevel; a long upright

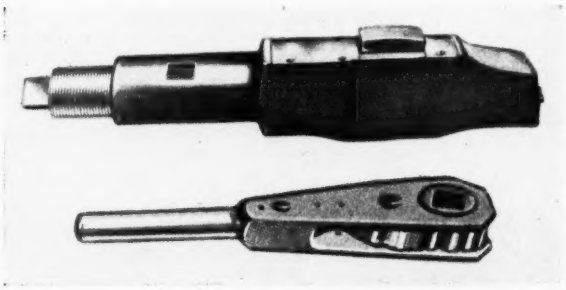
The New Tool in Operation

lever for moving the bit back and forth across the joint; a pointer for centering the machine over the joint; a foot lever for clamping the machine securely to the rail after it has been centered over the joint; an oil reservoir from which oil is supplied to lubricate the bit during the operation of the machine; two double-flanged rollers which support the tool on the rail and on which it is moved from joint to joint, a large wheel to facilitate the transportation of the grinder when it is not in use, and a long arm which reaches to the opposite rail and which has a cam-like attachment at that end for adjusting the bit to the proper level.

One man is sufficient to operate and handle this machine, which weighs 150 lb., and skilled labor is not necessary for its operation. Each bit end will cut approximately 40 joints and can then be resharpened for further use, it being possible to resharpen a bit four or five times before replacement becomes necessary. It is said that this machine is capable of cutting 20 to 30 joints an hour.

A New Type Bridge Jack

A STRIKING deviation from the usual design of bridge jacks is found in the Smith bridge jack, manufactured by the Clark Manufacturing Company, Philadelphia, Pa., this jack being operated on the roller and wedge principle and requiring only 4¾ in. headroom. The Smith jack consists essentially of a metal housing, two roller assemblies, a lifting wedge, a lift block and a driving screw. Assembled, it has an overall length of 32¾ in. and weighs 74 lb. Its



The Smith Bridge Jack and the Smith Ratchet Wrench for Operating the Jack

capacity is 150 tons and it has a maximum lift of 1 in.

The jack is operated by means of a wrench applied to the thrust screw, which, as it is turned up, drives the lifting wedge forward between an upper and lower racks of rollers. The rising rack of rollers over the wedge transmits the upward thrust directly to the lift block. The thrust screw, with six threads to the inch, has a maximum travel of eight inches. Thus, the maximum lift of the jack requires 48 complete turns of the screw.

Because of its great power and small overhead height, this jack can be used to advantage in many classes of bridge construction and repair work, and although its full lift is only one inch, lifts of greater height can be attained readily by blocking and reapplication of the jack. The jack is operated by one man, preferably with a ratchet wrench for speed of operation and where work must be done in close quarters. A suitable type of such wrench is also furnished by the Clark Manufacturing Company.

The Railway Industry at a Glance

Operating revenues and expenses of the Class I steam railways in the United States, from data compiled by the Bureau of Statistics, Interstate Commerce Commission

	Month of July			Seven Months Ending with July		
	1930	1929	Decrease 1930 under 1929, per cent	1930	1929	Decrease 1930 under 1929, per cent
Total operating revenues	$457,025,114	$558,386,427	18.0	$3,148,700,981	$3,626,465,517	13.1
Expenditures for maintenance of way and structures	**64,115,114**	**81,804,849**	**21.6**	**439,736,155**	**496,181,880**	**11.2**
Total operating expenses	331,561,567	389,257,586	14.7	2,405,088,119	2,638,986,809	8.8
Net railway operating income	82,750,151	123,824,672	33.2	458,943,343	686,391,088	33.2

WITH THE ASSOCIATIONS

Metropolitan Track Supervisors' Club

The first meeting of the fall of the Metropolitan Track Supervisors' Club will be held on October 16 at Keen's Chop House, 72 West Thirty-Sixth street, New York City. Dinner will be served at 6 p. m.

Maintenance of Way Club of Chicago

The tenth annual meeting of the Maintenance of Way Club of Chicago will be held at the Auditorium Hotel on Wednesday evening, October 15, preceded by a dinner which will be served at 6:30 p. m.

Bridge and Building Association

In addition to the program that was presented in the September issue, R. H. Aishton, president of the American Railway Association will speak at the opening session. Following the adjournment of the convention on Thursday noon, an inspection of the Louisville terminals and Belt line and of the various railway bridges over the Ohio river will be made by special train. On Friday a trip has been arranged to Mammoth cave, Ky.

American Railway Engineering Association

The energy of the association has been directed during the past month primarily to the completion of the committee reports in order to comply with the instructions of the board of direction that the reports be completed and in the hands of Secretary Fritch by November 1.

The Committee on Records and Accounts met at Detroit, Mich., on September 4, while the Committee on Ties met at Louisville, Ky., on September 15, with 15 present. Following this meeting the members of the latter committee inspected the ties in the yards of treating plants at Louisville and also at Carbondale, Ill., to ascertain the extent to which the A. R. E. A. specifications are being adhered to. The Roadway committee met at Chicago on September 15 with 18 present, and the Committee on Economics of Railway Labor in the same city on the same day with 15 present. The Committee on Track met in Chicago on September 17 with 30 present. The Masonry committee met in Toronto on September 17-18, the Committee on Economics of Railway Operation met in Chicago on September 18 and the Committee on Grade Crossings in the same city on the following day. The Committee on Buildings met in Boston September 23-24.

Committee meetings are already scheduled during the month of October as follows:

Yards and Terminals—Cleveland, October 6, 7 and 8; Water Service—Chicago, October 7; Records and Accounts—Chicago, October 9; Iron and Steel Structures—Washington, D. C., October 9-10; Uniform General Contract Forms—New York, October 10; Work Equipment—Chicago, October 17; Economics of Railway Labor—St. Louis, October 17; Ballast—Chicago, October 17; Wood Preservation—Chicago, October 21, and Rules and Organization—Chicago, October 24.

Of special interest was a meeting of the committee chairmen with members of the board of directors at Chicago on September 19 to consider ways of co-ordinating the work of committees and of condensing their reports and reducing the cost of their printing.

The Committee on Stresses in Track is now undertaking field tests on stresses in rail joints of various designs on track of the Pennsylvania System. The Ballast committee is making extensive hardness and abrasion tests on gravel and stone ballast materials, including both laboratory and field investigations.

The Electrical section, of the Engineering division of the A. R. A., formerly the Committee on Electricity of the A. R. E. A., will hold its annual convention in the Congress Hotel, Chicago on October 29-30, at which time reports will be presented by some 15 committees. The Electrical section has assembled and is reprinting, in a manual of some 200 pages, the recommendations which have been approved to date by the Committee on Electricity of the A. R. E. A. and by the Electrical section, A. R. A.

Bridge and Building Supply Men's Association

A total of 45 companies have already arranged for space in the exhibit of the Bridge and Building Supply Men's Association which will be presented in connection with the convention of the American Railway Bridge and Building Association at Louisville, Ky., on October 21-23. Among these firms are the following:

Aluminum Company of America, Pittsburgh, Pa.
American Hoist & Derrick Co., St. Paul, Minn.
American Rolling Mill Company, Middletown, Ohio
American Valve and Meter Company, Cincinnati, Ohio
Barrett Company, New York
Carter Bloxonend Flooring Company, Kansas City, Mo.
Celotex Company, Chicago
Chicago Bridge & Iron Works, Chicago
Clyde Iron Works Sales Company, Chicago
Concrete Materials Corporation, Chicago
Dearborn Chemical Company, Chicago
Detroit Graphite Company, Detroit
DeVilbiss Company, Toledo, Ohio
Paul Dickinson, Inc., Chicago
Duff-Norton Manufacturing Company, Chicago
Fairbanks, Morse & Co., Chicago
Fairmont Railway Motors, Inc., Fairmont, Minn.
Milo R. Hanke, Cincinnati, Ohio
Hastings Signal and Equipment Company, Boston, Mass.
High Grade Manufacturing Company, Cleveland, Ohio
Ingersoll Rand Company, New York
Ingot Iron Railway Products Co., Middletown, Ohio
International Derrick & Equipment Co., Columbus, Ohio
Insulite Company, Minneapolis, Minn.
Johns-Manville Sales Corporation, New York
Jones Paint Company, Rome, N. Y.
Kaustine Company, Inc., Perry, N. Y.
Lehon Company, Chicago
Lewis Asphalt Engineering Corporation, New York
Louisville Frog, Switch & Signal Co., Louisville, Ky.
Massey Concrete Products Corporation, Chicago
Midland Company, South Milwaukee, Wis.
Murdock Manufacturing & Supply Company, Cincinnati, Ohio
National Lead Company, New York
Nelson Water Service Company, Chicago
Ohio Valley Rock Asphalt Company, Louisville, Ky.
W. W. Patterson Company, Pittsburgh, Pa.
Phelps Drake Co., Inc., Minneapolis, Minn.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Pittsburgh Plate Glass Company, Paint and Varnish division, Newark, N. J.
Pocket List of Railroad Officials, New York
Railway Engineering and Maintenance, Chicago
Ruberoid Company, New York
Sherwin Williams Company, Cleveland, Ohio
U. S. Wind Engine & Pump Co., Batavia, Ill.

IN TWO STATES—The State Line freight house of the Missouri Pacific at Kansas City is so named because it extends into both the states of Missouri and Kansas. The state line passes through the freight house platform.

RAILWAY NEWS BRIEFLY TOLD

The Interstate Commerce Commission, on petition of the railroads, has postponed from October 1 to January 1 the effective date of its order prescribing a general revision of grain rates in the western district and for export. The postponement was asked on the ground that the time allowed was insufficient for the preparation of the tariffs. It has been estimated that the revision would reduce the revenues of the western roads by $15,000,000 a year.

As the result of an intensive program of freight damage prevention, which was begun in 1918, the Kansas City Southern has reduced the amount paid for loss and damage per $100 of revenue from $2.43 in 1919 to 32 cents in 1929. Loss and damage payments due to wrecks were reduced from $31,058 in 1921 to $963 in 1929; payments due to delay were cut from $10,064 to $4,002; and payments due to defective and unfit equipment were reduced from $80,897 to $6,763.

Class I railways of the United States placed 55,660 new freight cars in service during the first seven months of 1930, as compared to 42,552 in the same period last year, according to the Car Service Division of the American Railway Association. On August 1 the railways had 19,627 new freight cars on order, compared with 36,335 on the same date last year. During the first seven months the railways placed in service 484 locomotives, compared with 371 in the same period of last year, and new locomotives on order on August 1 of this year totaled 296, compared with 410 on the same day last year.

An order holding that the state full-crew law of Ohio does not apply to gas-propelled motor trains, which was issued recently by the Ohio Public Utilities Commission, has been appealed to the Ohio supreme court by the Brotherhood of Locomotive Firemen and Enginemen and the Brotherhood of Railroad Trainmen. The commission first held that the railroad must operate the trains with a full crew, but on a rehearing reversed its ruling. James Morris, attorney general of North Dakota, has issued an opinion that the North Dakota full-crew law does not apply to the operation of a gas-propelled vehicle on rails when it is run by itself and not as part of a train.

Litigation surrounding the Moffat tunnel was increased recently when Eastern bondholders petitioned the United States district court at Denver, Colo., for a writ of mandamus to compel the Moffat tunnel commission to pay approximately $500,000 interest, which is past due, on the $8,750,000 issue of supplemental bonds used for construction of the tunnel. The petition also asks the appointment of a receiver to take charge of all tunnel taxes already collected. The district court has already issued an injunction, in compliance with an order of the Colorado supreme court of January 20, prohibiting the payment of any interest on these bonds pending the court determination of their legality.

A resolution, containing a plea to governmental bodies, including the Interstate Commerce Commission, to take steps to discourage and prevent the further expansion of common carrier pipe lines at the expense of the railroads, was adopted by the international association of general chairmen of the Brotherhood of Railroad Trainmen during its annual convention at Denver, Colo., on August 28. The resolution points out that this particular means of transportation, coupled with automobiles, motor buses and airships, has and will continue to make greater inroads into the resources of the railroads and unless curbed or halted, is likely to undermine the financial structures of many of our railroad companies.

Freight traffic handled by the Class I railways in July amounted to 35,579,981,000 net ton-miles, a reduction of 6,429,418,000 net ton-miles, or 15.3 per cent, under July, 1929, and 3,572,947,000 net ton-miles, or 9.1 per cent, under July, 1928, according to reports compiled by the Bureau of Railway Economics. For the first seven months of this year the freight traffic handled by these roads totals 247,827,151,000 net ton-miles, a reduction of 32,691,274,000 net ton-miles, or 11.6 per cent, under the same period of 1929, and a reduction of 15,316,598,000 net ton-miles, or 5.8 per cent, as compared with the same seven months of 1928. The speed of freight trains in July was the highest for any July on record, being an average of 13.9 miles per hour, which represents an increase of 0.5 miles per hour over that for July, 1929.

J. Sanchez Mejorada, executive president of the National Railways of Mexico, has announced that a general reorganization of the lines has been undertaken with a view to the resumption of interest payments on the railroad's debt and acquisition of a greater control in the affairs of the company by the purchase of additional stock by the Mexican government. The government now owns 52 per cent of the stock and it plans eventually to obtain 65 per cent. It is also planned to cancel all projects for the construction of new lines within the near future and several branch lines that are not considered essential will be abandoned. The reorganization program also calls for the return of a number of independent lines, which are now operated by the National Railways, to their owners.

A controversy of many years' standing between the city of St. Louis, Mo., and the Terminal Railroad Association of St. Louis over the use of the Municipal bridge, which was constructed by the city to compete with the Eads and Merchants bridges, both of which are controlled by the railway, was terminated on August 13 by the announcement of an agreement between the city and the railway. Since its completion in 1927, the Municipal bridge has been used as a free highway bridge, but up to the present no use has been made of its railway facilities. According to the agreement, the railway will use the Municipal bridge for passenger and freight traffic and will pay the city on a wheelage basis, guaranteeing it a minimum annual return of $500,000. In return the railway will abolish tolls on vehicular traffic over the Eads bridge, except that which operates for hire, and will receive $140,000 from the city for the use of the bridge.

Southwestern Railways Push New Lines

The railroads serving the Southwest are now promoting an unusually extensive program of new line construction. This program, in which more than a dozen roads are participating, involves the construction of more than 2,100 miles of new lines in Texas, Colorado, New Mexico and Oklahoma. Of this mileage, about 1,100 miles is waiting the approval of the Interstate Commerce Commission, while that body has recently approved the construction of more than 800 miles. In addition, contracts have been awarded for the construction of about 200 miles of line, on a portion of which work is now in progress.

Construction News

Projects Contemplated

C. N. R.—Construction of a new brick passenger station, Parry Sound, Ont.

Carolina, Clinchfield & Ohio— Has applied to I. C. C. for permission to construct 2-mile line, including 700-ft. tunnel, Spartanburg, S. C., to effect connection with Charleston & Western Carolina.

C. & O.— Construction of highway subway at Pendleton ave., Bellevue, Ky., $88,000.

C. B. & Q.-C. & N. W.—State of Wyoming has filed complaint with I. C. C. to require these roads to construct extension from either of the parallel main lines in Fremont county, Wyo., to the Riverton project of the United States Reclamation Service, about 25 miles, and to connect their lines by 2.5 miles of new line between Bonneville on the C. B. & Q. and Shoshoni on the C. & N. W.

New Mex. Lumber Co.—Construction of line between McPhee, Colo., and Terris, 15 miles.

Northern Alta.—Plans filed with government of British Columbia for construction of extension from Hythe, Alta., to Lawson creek, 25 miles.

N. P.—Examiner Haskell C. Davis of the I. C. C. has submitted proposed report recommending the N. P. be allowed to construct line from Moclips, Wash., to points on Hoh river, 59.44 miles, instead of route already authorized from Aloha, Wash., to Hoh river, 67 miles.

Penna.—Construction of new 100-ft. turntable and extension of ash pits at enginehouse, South Oil City, Pa., $140,000.

Stockton, Cal.—Has applied to I. C. C. for authority to construct 23,500-ft. spur track as part of proposed belt line around Stockton deep-water project.

T. & P.— Has filed application with I. C. C. for authority to build 333 miles of new lines in Texas; fom Big Spring, Howard county, to Vega, Oldham county, 232 miles; from a connection with this line in Terry county to Lubbock, 46 miles, and from a connection with the first line near Dimmitt to Amarillo, 55 miles.

Warren Central— Has applied to I. C. C. for authority to construct new line from Hockley, Texas., to Katy, 15 miles.

Approved by Commissions

C. N. R.—Ordered by Bd. of Ry. Com'rs of Can. to proceed with the construction of branch line from Luscar, Alta., to serve the Gebo Coal Co.

C. & O.—Campbell county (Ky.) circuit court has entered order requiring this road to construct highway subway at Pendleton ave., Bellevue, Ky.

C. G. W.—By Missouri State Highway Commission to construct concrete viaduct over Highway No. 45, Beverly, Mo., $32,000.

D. & H.—By Pub. Serv. Com. of N. Y. to eliminate Pony Farm, Crandall and Glen Bridge grade crossings, Oneonta and Otego, N. Y. First two, Oneonta, to be closed by construction of 1.73-mile lateral highway, $116,230; latter to be closed by construction overhead crossing, $69,000. General plan and estimate of $284,976 for elimination of Mill road, Ft. Hunter road and Campbell ave. grade crossings, Rotterdam and Schenectady, N. Y.; plans for elimination of grade crossings at Boardman, Main, Church and Bellamy sts., Whitehall, N. Y., by rerouting of line and construction of overhead crossings, $851,000; and plans for elimination North Park ave. grade crossing, Cambridge, N. Y., all approved by Pub-Serv. Com. of N. Y.

Genesee & Wyoming—Plans and estimate of cost of $58,000 for reconstruction structure carrying Pavilion-Greigsville highway over tracks, York, N. Y., approved by Pub. Serv. Com. of N. Y.

L. V.—By Pub. Serv. Com. of N. Y. to eliminate Twogoods, Halls and Bulls highway crossings, Lincoln, N. Y., by construction lateral highway on north side of road.

N. Y. C.—Specifications and estimate of $151,700 for elimination grade crossing on Utica-Frankfort state highway, Utica, N. Y., and for elimination Stop No. 2 crossing, Frankfort, N. Y., approved by Pub. Serv. Com. of N. Y., also for elimination of Echo Lake-Pines Bridge county highway crossing, New Castle, N. Y.; plans for elimination grade crossings at Railroad st. and Church st. West, Adams, N. Y., approved by Pub. Serv. Com. of N. Y. Com. has granted petition of Niagara county, N. Y., asking increases in width of grade separation structures to be built by N. Y. C. at Military road crossing, Niagara Falls, N. Y., and at Sanborne-Lockport road, Cambria, N. Y., which will increase total cost of two projects, $65,600.

Penna.—Estimates of $54,800 and $31,500 for elimination two grade crossings with Horsehead-Montour Falls state highway, Veteran, N. Y., approved by Pub. Serv. Com. of N. Y.; plans for elimination grade crossings at South Main, Miller and LaFrance sts. and South ave., Elmira, N. Y., approved by Pub. Serv. Com. of N. Y. Com. has also approved plans and estimates for elimination Hitcomb, Shreve and Osborn crossings, Clymer and Sherman, N. Y., $31,400, and for the elimination of the Castile road crossing, Genesee Falls, N. Y., $127,150.

Projects Authorized

Montana Power Co.— Construction branch line from Pablo, Mont., on N. P. to new power plant on Flathead river, 9 miles.

Bids Received

C. N. R.—For construction overhead viaduct from north end Victoria bridge across St. Lawrence river to this road's new passenger terminal in heart of Montreal, Que.; also for construction of bridges to carry Guy and Mountain sts. over tracks at entrance to Bonaventure station area, Montreal; both of latter bridges to be of concrete and steel construction and 740 ft. and 900 ft. long.

L. A. & S. L.—On Sept. 5 for grading, bridging and construction of line from 2.2 miles west of Bracken, Nev., to proposed Boulder dam on Colorado river, consisting of 22.7 miles main track and 5.2 miles secondary track, $840,000.

Pacific Great Eastern—Construction sub-structure of new bridge over Fraser river, Lillooet, B. C.

Term. R. R. Assn. St. Louis, Mo.—For construction Merchandise Mart, St. Louis, of reinforced concrete, brick and stone, 8 stories with 20-story tower.

Contracts Awarded

Algoma Central & Hudson Bay—Dredging a harbor and construction of 310-ft. extension to present coal dock, Michipicoten, Ont.—A. B. McLean & Son, Sault Ste. Marie, Ont., $250,000.

A. T. & S. F.—Construction grade separation structures at Aves. 19, 20 and 26, Los Angeles, Cal.—Robert E. McKee, Los Angeles; construction for Santa Fe Coast Lines Hosp. Assn. of 3-story reinforced concrete building for nurses' residence, Los Angeles—Lynch Const. Co., Los Angeles; construction foundations for highway subway, Wasco, Cal.—W. A. Bechtel Co., San Francisco, Cal.; construction 310-ton reinforced concrete coaling station, Grants, N. M.—Fairbanks, Morse & Co., Chicago; construction of 2-story concrete, brick and stone office building, Ft. Madison, Iowa—George Senne, Topeka, Kan.

B. & M.— Reconstruction of bridge, Buckland, Mass.—New England Const. Co., Springfield, Mass.; installation of four two-track, single-leaf, rolling lift bridges, Boston, Mass., from 87 ft. 9 in. to 118 ft. in length; substructure—Stuart & Sons Co., Watertown, Mass.; erection of superstructure — Phoenix Bridge Co., Phoenixville, Pa.; installation of electrical operating equipment—Norwood-Noonan Co., Chicago, three contracts, $1,000,000.

C. N. R.—Construction reinforced concrete and steel highway subway, Pembina highway, Winnipeg, Man.—Foley Bros., Ltd., Winnipeg, $500,000. Construction of superstructure of highway subway at B West st., Brantford, Ont.—A. Lothian, Brantford, to carry two main tracks, two passing tracks and a station platform and to be constructed of precast concrete slabs; construction of passenger station, Owen Sound, Ont., of brick and stucco on concrete foundation—G. H. Thomas & Son, Ltd., Galt, Ont.; construction of a freight line on outskirts of Regina, Sask., east of Winnipeg st.—P. Wheelock, Regina. Construction of subway under four tracks at 97th st., Edmonton, Alta.; general work—Jamieson Const. Co., Edmonton; fabrication of superstructure—Dominion Bridge Co., Calgary, Alta.

C. P. R.—Grading for extension from Vanguard, Sask., to point on Weyburn (Sask.)-Lethbridge (Alta.) line, 35 miles—Fred Mannix, Calgary, Alta. Construction of freight stations and offices, Prince Albert, Sask., Humboldt and North Battleford—R. N. Wyatt, Winnipeg, Man. Construction of buildings, Toronto, Ont., including a storehouse, a yard office, a repair shop, a linen storage building, truck platforms, two standpipes, a bunk house and an addition to the enginehouse—Anglin-Norcross, Ltd., Toronto, $500,000.

C. & O.—Addition to Calumet elevator A, South Chicago, Ill.—M. A. Long Co., Baltimore, Md., $300,000.

C. & N. W. — Construction new express terminal near Madison st. station, Chicago, exclusive of mechanical facilities—Anderson & Co., Chicago.

D. & H.—Elimination of Coopersville station crossing on Chazy-Rouses Point state highway, Champlain, N. Y.—Peckham Const. Co., Buffalo, N. Y., $37,944; elimination Warren st. crossing on Sandy Hill-Glens Falls county highway, Queensbury, N. Y.—Scott Bros. Const. Co., Rome, N. Y., $70,878; and elimination of Curriers crossing on Curriers Corners-Fort Amherst county highway, Crown Point, N. Y. — Peckham Const. Co., $95,516.

Erie-N. Y. C. & St. L. — Construction produce terminal and market, Buffalo, N. Y., including four fireproof buildings, 70 ft. by 264 ft., and one 82 ft. by 100 ft.—J. W. Cowper, Inc., $1,000,000.

Goodyear Yellow Pine Co.—Clearing of right of way and grading for eight miles new line, Picayune, Miss.—G. H. Williams, Picayune.

Kansas City Term.—Construction of substructure of grade separation structure at Oak Street, Kansas City, Mo.—J. W. McMurry Contr. Co., Kansas City.

L. A. & S. L. — Grading, bridging and construction of culverts for new line from 2.2 miles west of Bracken, Nev., to summit of proposed Boulder dam on Colorado river — Merritt - Chapman & Scott Corp., San Pedro, Cal.

N. Y. C. — Construction projects in New York City to New York contractors, as follows: Paving and other work at 30th st. yard—William J. Fitzgerald; covering openings and strengthening roof of Park ave. tunnel between 86th and 96th sts.—H. H. Sherwin & Co., Inc.; foundations for city structure No. 2 from West 59th st. to West 72nd st.—Senior & Palmer, Inc.; foundations for new warehouse at West End ave. between 62nd and 64th sts. — Babor-Comeau & Co., Inc.

Oneida & Western — Construction of extension from terminus, East Jamestown, Tenn., southwesterly 9 miles—Cook & Elliot, Oneida, Tenn., $95,000.

Pacific Great Eastern—Fabrication of superstructure of new bridge over Fraser river, Lillooet, B. C. — Dominion Bridge Co., Toronto, Ont., total cost, $200,000. Construction of substructure of bridge—Stewart & Barber, Vancouver, B. C., $60,000, to be completed before May 31, 1931.

Penna. — Construction of protection fenders along new channel at bridges 4.21 and 4.25, Jersey City, N. J.—Allen N. Spooner & Son, Inc., New York, $61,000; erection of superstructure of cattle-pen building, 39th st. and Gray's Ferry ave., Philadelphia, Pa.—Turner Const. Co., Philadelphia, $469,700; construction storm sewer, paving, inlets and other work for elimination grade crossing at Chester ave., Swarthmore, Pa.—S. Joseph McHugh, Philadelphia, $57,800.

P. M. — Revision of grade and track extensions, St. Joseph, Mich.—Stevens Const. Co., Cleveland, Ohio, $96,000; installation new turntable and extension turntable pit, Grand Rapids, Mich.—Barnes Bros. Const. Co., Grand Rapids, $78,000; construction grade separation structures at Fort st. and Dix ave. Detroit, Mich.—The Jutton Kelly Co., Detroit, $300,000 and $250,000; construction new water-treating plant, Wyoming yard, Grand Rapids—The Nelson Water Service Co., Chicago, $50,000; installation of locomotive coaling equipment, Grand Rapids—Roberts & Schaefer Co., Chicago.

P. & L. E.—Construction branch line from Monaca, Pa., to Bellowsville, 3 miles — Ferguson & Edmondson Co., Pittsburgh, Pa.

S. A. L.—Foundations and substructure for steel viaduct over the Appomattox river, Petersburg, Va., to replace existing wood and steel bridge—Cornell-Young Co., Macon, Ga.; superstructure—American Bridge Co., New York; grading for underpass at South st., Petersburg—Gresham & Ware and W. W. Winfree.

S. P.—Construction tuberculosis sanitarium, Tucson, Ariz.—Robert E. McKee, El Paso, Tex., $135,000.

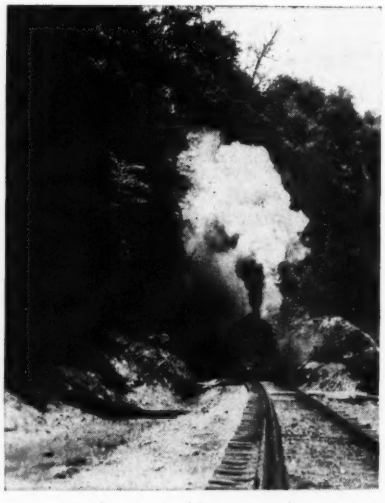
Temiskaming & Northern Ontario—Construction last lap of extension from Moose River, Ont., to terminal point on James Bay—H. F. McClean Co., Ltd., Toronto, Ont.; steel superstructure for bridge over Moose river on James Bay extension—Hamilton Bridge Co., Ltd., Hamilton, Ont.

Union — Construction 200 - ton automatic electric reinforced concrete coaling station, sand - drying and storage plant and electric cinder plant, Munhall, Pa., and reinforced concrete coaling station, sand plant and cinder plant, Rankin, Pa.—Roberts & Schaefer Co., Chicago, total $60,000.

Wab.—Construction addition to engine house, Decatur, Ill., and wash and locker building at same point, $100,000.

West. Mary.—Repairs to grain elevator, Port Covington, Md.—The M. A. Long Co., Baltimore, Md., $75,000.

The Atchison, Topeka & Santa Fe has announced a day-coach fare of $47.50 from Chicago to California points for the month of November, or $32 less than the regular fare.



On the Eastern Kentucky Division of the Louisville & Nashville

Supply Trade News

General

The Inland Steel Company is reclaiming 50 acres from Lake Michigan for the future expansion of the Indiana Harbor (Ind.) plant.

The American Manganese Steel Company, Chicago Heights, Ill., has moved its Cleveland, Ohio, office to room 909, Midland Bank building.

The Chicago Bridge & Iron Company, Chicago, has opened a branch office at 422 Smith Tower, Seattle, Wash. **R. L. Hilton** has been placed in charge.

The Ramapo - Ajax Corporation has awarded a general contract to the **Missouri Bridge & Iron Company** for the construction of a one-story addition to its plant at St. Louis, Mo., to cost $25,000.

The Sheffield Steel Corporation, Kansas City, Mo., has opened an office at 1122 Straus building, Chicago, under the direction of **Ernest Baxter,** who has been elected vice - president, railroad division.

Burton Explosives, Inc., Cleveland, Ohio, a sales organization, has entered the explosives and chemical manufacturing field and is constructing a plant at Cleveland which will have an initial production of 12,000,000 lb. of high explosives in 1931.

The Wood Preserving Corporation, Pittsburgh, Pa., has been formed to take over the **Ayer & Lord Tie Company,** Chicago, and the **Century Wood Preserving Company,** Pittsburgh. The Ayer & Lord Tie Company was acquired by the **American Tar Products Company** in June, 1930, and the Century Wood Preserving Company in August, 1930. Under the new arrangement, the Ayer & Lord Tie Company and the Century Wood Preserving Company will be controlled by the parent company, but will continue under their present names and managements.

Personal

A. H. Shaffert, works manager of the **Truscon Steel Company,** Youngstown, Ohio, has been elected vice-president.

F. A. Rumberger has been appointed a representative of the **Browning Crane Company,** with headquarters at Cleveland, Ohio.

F. O. Farey, representative of **Robert W. Hunt & Company, Ltd.,** with headquarters at Montreal, Que., has been promoted to general manager with the same headquarters.

Frank Parker, vice-president and general manager of **Briggs & Turivas,** Blue Island, Ill., has resigned and has organized **Iron & Steel Products, Inc.,** with offices in the Railway Exchange building, Chicago.

B. H. MacNeal has been appointed southern district manager of the crane-

shovel-dragline division of the **Link-Belt Company,** Chicago. Mr. MacNeal will have his headquarters at Birmingham, Ala.

James H. Edwards, chief engineer of the American Bridge Company, whose death was noted in the September issue, was born in 1864, at Oxford, N. Y. He

James H. Edwards

graduated from Cornell University in civil engineering in 1888, and then served as chief engineer of the Berlin Iron Bridge Company, East Berlin, Conn., until it was absorbed by the American Bridge Company in 1900. Mr. Edwards served as engineer of the structural department of the American Bridge Company, and from 1901 until August, 1927, he was assistant chief engineer. On the latter date he was appointed chief engineer, which position he held until his death.

John A. Roche has been appointed sales representative in the Chicago district for the frog, switch and crossing reclamation department of the **Electric Railweld Sales Corporation,** Chicago, with headquarters in the Buckingham building, Chicago.

Harry T. Gilbert, vice-president in charge of sales of the **Republic Steel Corporation,** Youngstown, Ohio, has been appointed assistant to the president, with headquarters at Youngstown, and has been succeeded by **Norris J. Clark,** vice-resident and chairman of the executive committee of the **Lamson & Sessions Company,** Cleveland, Ohio.

C. B. Nolte, vice-president and general manager of the **Robert W. Hunt Company,** Chicago, has been elected president and general manager, with headquarters at Chicago, to succeed **John J. Cone,** who has retired. **J. C. Ogden,** a director and eastern manager of the company, has been elected vice-president, with headquarters at New York.

George A. Morison, vice-president and treasurer of the **Bucyrus-Erie Company,** South Milwaukee, Wis., has relinquished his duties as treasurer, but remains as vice-president in charge of finance, commercial and corporation matters. **John G. Miller,** manager of domestic sales, has been appointed treasurer and has been succeeded by **P. H. Brickhead,** assistant manager of domestic sales.

A. D. Cook, Inc., Lawrenceburg, Ind., has opened an office at Grand Rapids, Mich. **James R. Hamilton,** sales representative of this company, has been placed in charge of the new office and **H. B. Allen Sickel,** formerly vice-president and chief engineer of the **Layne-Ohio Company,** is consulting engineer and superintendent of gravel-packed well installations.

T. J. Clancy has been appointed manager of the Pittsburgh territory of the **Independent Pneumatic Tool Company,** Chicago, with headquarters at Pittsburgh, Pa., to succeed **F. J. Passino,** who has been transferred to the St. Louis territory, with headquarters at St. Louis, Mo. Mr. Passino replaces **W. A. Nugent,** who has been appointed manager of the Chicago territory, with headquarters at Chicago.

I. Lamont Hughes, vice-president of the **United States Steel Corporation,** at New York, has been elected president of the **Carnegie Steel Company,** Pittsburgh, Pa., succeeding **William G. Clyde,** who has resigned on account of ill health. **Ambrose N. Diehl,** vice-

Sydney Dillon

president of the Carnegie Steel Company, has resigned to become a vice-president of the United States Steel Corporation, with headquarters at New York, and **Ralph H. Watson,** general superintendent of the Homestead (Pa.) works of the Carnegie Steel Company succeeds Mr. Diehl as vice-president and a director of the Carnegie Steel Company, with headquarters at Pittsburgh. **Sydney Dillon,** chief mechanical engineer of the Carnegie Steel Company, has been appointed assistant to the vice-president.

Mr. Dillon was born at Altoona, Pa., on June 21, 1877, and was educated in the schools at Braddock. From 1899 to 1916, he held various positions with the Carnegie Steel Company, including that of assistant chief engineer at the Edgar Thomson works, and then as chief mechanical engineer of the Carnegie Steel Company until his recent appointment as assistant to the vice-president as above noted.

Mr. Clyde was born at Chester, Pa., and was educated at the Pennsylvania Military College, from which he was graduated in 1888. He began work as a civil engineer with Ryan & McDonald, constructors, Baltimore, Md., and later became associated with Robert Wetherall & Company, machinists and founders of Chester. Mr. Clyde began his mill training with the Wellman Steel & Iron Company, Thurlow,

William G. Clyde

Pa., as superintendent of the plate mills. He subsequently went to the Illinois Steel Company at South Chicago where he remained for six years. He then was appointed sales manager of the American Steel Hoop Company at Philadelphia, remaining in that position until that company was taken over by the Carnegie Steel Company. After serving for three years in sales work at the Cleveland offices, Mr. Clyde was appointed assistant general sales manager of the Carnegie Steel Company, with headquarters at Pittsburgh and from March, 1918, he served as vice-president, general manager of sales and a director until his election as president of the same company in November, 1925.

Mr. Watson was born at Harvey, N. B., on January 7, 1878, and graduated from the Lawrence Scientific School, Harvard University. He has been in

Ralph H. Watson

the service of the Carnegie Steel Company since 1902, having begun as a metallurgist's assistant at the Homestead works. He later held various

positions until his appointment in April, 1928, as general superintendent of the Homestead works. He now becomes a vice-president of the Carnegie Steel Company.

Mr. Diehl was born in York county, Pa., on October 20, 1876, and was graduated from York Collegiate Institute, York, Pa., in 1894, receiving from the Pennsylvania State College the de-

Ambrose N. Diehl

gree of B. S. in 1898. He has been connected with the steel business since 1899, serving in various positions. In 1918, he was appointed general superintendent of the Duquesne works of the Carnegie Steel Company. Since January, 1925, Mr. Diehl has been a vice-president of that company.

Mr. Hughes was born at Mercer, Pa., in January, 1878, and commenced his career with the Edgar Thomson works of the Carnegie Steel Company in September, 1897. He took charge of engineering for the Union Steel Company, now part of the American Steel & Wire Company in June, 1901, and in January, 1905, he became master mechanic of the bar mills of the Youngstown district of the Carnegie Steel Company. He was appointed assistant general superintendent of the bar mills in March, 1906, and five years later became general superintendent, being ap-

I. Lamont Hughes

pointed assistant general superintendent of the entire Youngstown district in January, 1916. He subsequently served as general superintendent in charge of the Canadian Steel Company's project at Ojibway, Ont., and was transferred in June, 1918, to the Neville Island gun plant at Neville Island, Pa., as general superintendent of the operations being carried out by the United States Steel Corporation for the government. Mr. Hughes became president of the Lorain Steel Company, a subsidiary of the United States Steel Corporation, in May, 1919, returning to the Carnegie Steel Company, Youngstown, as general superintendent in January, 1920. Five years later he became vice-president of the Carnegie Steel Company and since April, 1928, has served as a vice-president of the United States Steel Corporation.

W. J. Walsh, formerly vice-president of the **Galena Signal Oil Company,** with headquarters at Chicago, has been elected vice-president and general manager of the **Continuous Rail Crossing Corporation,** with headquarters at Chicago. Mr. Walsh entered railway service in 1886 as an apprentice in the shops of the Cleveland, Cincinnati, Chicago & St. Louis at Cleveland, Ohio. In 1889, he was made a machinist on the Cincinnati, New Orleans & Texas Pacific, and during the period to 1891 was a locomotive engineman, a general

W. J. Walsh

foreman and mechanical instructor on the first air-brake car ever constructed. In the latter year he was promoted to division master mechanic, which position he held until 1896, when he resigned to become lubrication engineer with the Galena Signal Oil Company at Chicago. In 1910, he was promoted to manager of the Chicago district, and on February 4, 1920, was elected vice-president, which position he held until his resignation on January 1, 1928. During the past two years, he has acted in a consulting capacity on problems of lubrication for various railroads and industries.

John M. Mulholland, whose promotion to vice-president in charge of sales of the **O. F. Jordan Company,** East Chicago, Ind., was noted in the September issue, was born at Pittston, Pa. He was educated at the Pittston high school, the Wyoming seminary at Kingston, Pa., and attended the University of Michigan from 1906 to 1910, where he studied marine engineering. Following his graduation, he served as an apprentice in marine engineering with the Craig Shipbuilding Company, Long Beach, Cal., and later engaged in mining engineering in the southwest and in Mexico. From 1913 to 1915, he was in South America as a mining engineer with the Bolivia Exploration Company. Later he became connected

John M. Mulholland

with the engineering department of the Liquid Carbonic Company of Chicago, and then entered military service, being assigned to the officers' training school, tank corps, Camp Colt. From 1919 to 1923, he was district sales manager of Mudge & Company, and from 1923 to 1928, he was identified with the oil equipment business, with headquarters at St. Louis, Mo., and Cleveland, Ohio. Two years ago he became connected with the sales department of the O. F. Jordan Company, remaining in that capacity until his recent promotion to vice-president in charge of sales.

Trade Publications

Floor Plates.—The Alan Wood Steel Company, Conshohocken, Pa., has published a 7-page pamphlet describing and illustrating its Diamondette rolled steel floor plate for use on car platforms, floors and steps, highway crossings and other places where carrying capacity in the plate itself is not essential.

Caterpillar Tractors.—Two booklets have just been issued by the Caterpillar Tractor Company, Peoria, Ill., one depicting largely by illustrations the use of caterpillar tractors in railway work, and the other describing and illustrating a new rolled steel caterpillar shoe, designed to withstand greater abuse in service.

Welding and Cutting Equipment.—The Torchweld Equipment Company, Chicago, has published catalogue No. 29, containing a complete price list of various types of cutting and welding equipment and accessories that this company has on the market. The booklet is complete with illustrations and a description of the uses and purpose of each unit.

Personal Mention

General

E. H. Dresser, chief engineer of the Duluth, Missabe & Northern, with headquarters at Duluth, Minn., has also been appointed vice-president, with the same headquarters. Mr. Dresser was born on October 9, 1878, at Jefferson, Iowa, and received his education at Rensselaer Polytechnic Institute. He commenced his railway career in September, 1899, with the engineering department of the D. M. & N., being subsequently advanced to division engineer. He left the service in 1918 to join the army, returning to civil life in 1919, when he became engaged in the general contracting business in Texas, becoming chief engineer of the Polaris Concrete Products Company in 1920. On January 16, 1928, Mr. Dresser was appointed chief engineer of the D. M. & N., which position he held until his recent appointment. On January 10 of this year, Mr. Dresser's jurisdiction as chief engineer was extended to include the Duluth & Iron Range, of which the D. M. & N. had acquired control.

E. H. Dresser

Engineering

H. M. Stout, record engineer of the Northern Pacific, with headquarters at St. Paul, Minn., has been appointed assistant valuation engineer at the same point. The position of record engineer has been discontinued.

W. Fields, division engineer of the San Antonio division of the International-Great Northern, with headquarters at Palestine, Tex., has had his jurisdiction extended to include the territory between San Antonio and Palestine, Tex.

W. H. Miesse, division engineer of the Terre Haute division of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Washington, Ind., has been transferred to Evansville, Ind., as division engineer of the Cairo-Terre Haute division.

A. W. White, assistant division engineer on the Chesapeake & Ohio, at Ashland, Ky., has been promoted to division engineer of the Richmond division, with headquarters at Richmond, Va., succeeding **T. H. Greene,** who resigned on September 8.

W. S. Wilson, division engineer of the Allegheny division of the Pennsylvania, with headquarters at Oil City, Pa., has been transferred to the Monongahela division, with headquarters at Uniontown, Pa., where he succeeds **L. B. Young,** whose transfer to the Schuylkill division was noted in the September issue.

F. J. Taylor, district engineer on the Northern Pacific, with headquarters at Livingston, Mont., has been transferred to St. Paul, Minn., succeeding **H. F. Brown,** who has been appointed assistant district engineer with the same headquarters. The position of district engineer at Livingston has been abolished.

E. W. Backes, division engineer of the Connecticut River division of the Boston & Maine, with headquarters at Springfield, Mass., has been appointed assistant division engineer of the Fitchburg division, with headquarters at Greenfield, Mass., following the consolidation of the Connecticut River division with the Southern and Fitchburg divisions.

L. J. Hughes, engineer maintenance of way of the Chicago, Rock Island & Pacific with headquarters at Chicago, has been appointed engineer maintenance of way of the First district, with headquarters at Des Moines, Iowa, succeeding **A. C. Bradley,** who has been appointed division engineer of the Iowa division, with the same headquarters. Mr. Bradley succeeds **W. E. Heimerdinger,** who has been transferred to the Cedar Rapids division, with headquarters at Cedar Rapids, Iowa. The position of engineer maintenance of way at Chicago has been abolished.

Roy Leas, assistant to the engineer maintenance of way on the Chicago, Rock Island & Pacific, has been appointed office engineer in the office of the engineer maintenance of way, with headquarters at El Reno, Okla., succeeding **E. A. Matney,** who has been appointed assistant engineer, with headquarters at Little Rock, Ark.

Coincident with the consolidation of the Rio Grande and the New Mexico divisions of the Atchison, Topeka & Santa Fe, **O. F. Arthur,** division engineer of the Rio Grande division, with headquarters at Albuquerque, N. M., has been transferred to the Slaton division of the Panhandle & Santa Fe, with headquarters at Slaton, Texas, to succeed **L. V. Lienhard,** who has been appointed assistant division engineer, with headquarters at San Angelo, Texas. **A. B. Truman,** division engineer of the New Mexico division, with headquarters at Las Vegas, N. M., has jurisdiction over the new division, which is now known as the New Mexico division. Also, coincident with the consolidation of the Arkansas River division with the Colorado division, under the name of the Colorado division, **J. A. Noble,** division engineer of the Arkansas River division, with headquarters at La Junta Colo., has been transferred to the Pecos division, with headquarters at Clovis, N. M.

J. L. Starkie, whose promotion to division engineer on the Gulf, Colorado & Santa Fe was mentioned in the September issue, has been engaged in railway engineering and construction work for more than 25 years. He was born in October 27, 1883, at Worcester, Mass., and graduated from the University of Kansas in 1905. He commenced his railway career immediately thereafter by joining the engineering department of the Kansas City, Mexico & Orient (now part of the Atchison, Topeka & Santa Fe), where he served as chainman, rodman and instrumentman on the construction of new lines in Kansas, Oklahoma, Texas and Mexico. In May, 1909, Mr. Starkie was promoted to resident engineer, in which position he divided his time between maintenance and construction work. In December, 1913, he left the K. C. M. & O. to become a draftsman on the G. C. & S. F. at Galveston, Texas, being advanced to office engineer in April, 1914. During federal control of the railroads, Mr. Starkie served as office engineer until August, 1918, when he was appointed assistant chief engineer of Group VI of the Southwestern region, with headquarters at Dallas, Texas, returning to the position of office engineer on the G. C. & S. F. at Galveston, Texas, in October, 1919. In July, 1924, he was appointed manager and operator of the railroad ballast plant at Brownwood, Texas, which position he retained until his recent promotion to division engineer.

W. W. Wilson, whose promotion to district engineer on the Gulf, Colorado & Sante Fe, was announced in the September issue, has served the engineering department of that road with but slight interruption for 31 years. He was born on January 2, 1882, at Hearne, Tex., and received a degree in civil engineering from the University of Texas in 1906. Prior to his graduation, Mr. Wilson served the G. C. & S. F. as a track laborer from January, 1899, until January, 1901, and as an axeman in the engineering department from the latter date until September, 1902, on which date he left the service to enter school. In June, 1906, immediately after leaving school, he re-entered the service of the G. C. & S. F. as a transitman on construction and maintenance, being in April, 1909, appointed assistant engineer on the Beaumont division. In January, 1910, Mr. Wilson was promoted to division engineer of the Galveston division, with headquarters at Galveston, Tex., and from November, 1918, until April, 1920, during Federal

control of the railways, he served as engineer maintenance of way of the Galveston Terminal Association, returning to the position of division engineer at Galveston on the latter date. In October, 1921, he was transferred to the Southern division, with headquarters at Temple, Tex., where he remained until his recent promotion to district engineer, with headquarters at Galveston, effective August 15.

Track

G. D. Dowden, track foreman on the Indianapolis division of the Pennsylvania, has been promoted to assistant track supervisor on the Toledo division.

A. Mahoney, roadmaster on the Missouri-Kansas-Texas, with headquarters at Parsons, Texas, has had his territory extended to include that of **T. G.** Banks, who has resigned.

E. A. Wheaton, track foreman on the Baltimore & Ohio, with headquarters at Sherwood, Ohio, has been promoted to supervisor of road, with headquarters at Defiance, Ohio, succeeding **H. J. Miller,** who has retired.

J. Cranford, roadmaster on the Missouri Pacific, with headquarters at Benton, Ark., has been transferred to Gurdon, Ark., to replace **L. J. Ward,** who has been transferred to Little Rock, Ark. Mr. Ward succeeds **M. Leonard,** who has been transferred to Dermott, Ark.

W. McDonald, roadmaster on the Campbellton division of the Canadian National, with headquarters at New Carlisle, Que., has had his jurisdiction extended to include the territory of **W. McEwen,** retired. **J. F. Gaul** has been appointed assistant roadmaster at New Carlisle.

C. Johnson, roadmaster on the Atchison, Topeka & Santa Fe, with headquarters at San Bernardino, Cal., has been transferred to Oceanside, Cal., to succeed **O. Gabriel,** who has retired. The territory over which Mr. Johnson formerly had jurisdiction has been divided between **A. Ray,** roadmaster at San Bernardino, and **A. L. Pollock,** roadmaster at Los Angeles, Cal.

W. T. Miller, assistant supervisor on the Maryland division of the Pennsylvania, with headquarters at Perryville, Md., has been transferred to the Philadelphia Terminal division, with headquarters at South Philadelphia, Pa., to succeed **H. A. Holzer,** who has been promoted to supervisor on the Williamsport division, with headquarters at Lewisburg, Pa.

H. D. VanVranken, whose promotion to supervisor on the Grand Rapids division of the Pennsylvania, was noted in the September issue, was born on December 15, 1897, at Schenectady, N. Y., and attended Norwich University and later the Tri-State College of Engineering, graduating from the latter with a civil engineering degree in 1921. On June 26, 1922, he commenced his railway career as an assistant on the engineer corps of the Ft. Wayne division of the Pennsylvania. After being advanced through various positions in the engineering department, he was promoted to assistant supervisor on the same division, with headquarters at Upper Sandusky, Ohio, on August 1, 1928, which position he retained until his recent promotion to supervisor on the Grand Rapids division, with headquarters at Petoskey, Mich.

W. L. Clifton, acting roadmaster on the Union Pacific, with headquarters at Green River, Wyo., has been promoted to roadmaster at Laramie, Wyo., to succeed **D. R. Byrne,** who has been transferred to Green River. Mr. Clifton was born on April 20, 1886, at Newark, Mo., and commenced his railway career at the age of 15 years as a trackman on the Chicago, Rock Island & Pacific, later serving as track foreman and roadmaster. He left the Rock Island in 1912, and went with the Utah Construction Company where he remained until 1915, when he re-entered railway service as a trackman on the Union Pacific. In 1925, Mr. Clifton was promoted to roadmaster at Columbus, Neb., serving in this position until 1928, when he went to Chile, S. A., to become a roadmaster on the railways of the Anglo-Chilian Consolidated Nitrate Corporation, with headquarters at Tocopilla, Chile. After about two years service he returned to the United States and resumed his service with the Union Pacific.

Bridge and Building

H. R. Morris, assistant master carpenter on the Ft. Wayne division of the Pennsylvania, with headquarters at Ft. Wayne, Ind., has been promoted to master carpenter of the St. Louis division, with headquarters at Terre Haute, Ind., succeeding **C. E. Hemminger,** who has retired after nearly 38 years service with the Pennsylvania. **John Bailey,** carpenter foreman on the St. Louis division, at Terre Haute, has been promoted to assistant master carpenter, with headquarters at Ft. Wayne.

H. B. Endsley, steel erection foreman on the Union Pacific, has been promoted to supervisor of bridges and buildings, with headquarters at Green River, Wyo., to succeed **Harry Francis.** Mr. Endsley was born on December 5, 1885, at Alton, Kan., and after receiving a grade school education commenced his railway service on November 7, 1903, with the Union Pacific. He has been with this company continuously since the latter date and has advanced successively through various positions in the bridge and building department.

W. T. Sprague, whose promotion to supervisor of bridges and buildings on the Texas & New Orleans (part of the Southern Pacific), was noted in the September issue, was born in 1869, at Victoria, Texas, and commenced his railway career in 1900 as a bridge and building carpenter on the Atchison, Topeka & Santa Fe. He served in this capacity and as bridge and building foreman until 1904, when he left the Santa Fe to become a bridge and building foreman on the Southern Pacific, which position he held until 1922, when he was promoted to supervisor of bridges and buildings. In 1926, Mr. Sprague was appointed assistant supervisor of bridges and buildings, holding this position until July 24 of this year when he was again promoted to supervisor of bridges and buildings, with headquarters at Victoria, Texas.

Obituary

S. J. Bratager, who retired as assistant chief engineer of the Northern Pacific on June 1, 1925, died on August 30 after a long illness.

E. H. Strine, supervisor of track on the New York Central, with headquarters at Gibson, Lake county, Ind., died on September 13.

W. C. Wolfe, track supervisor on the Pennsylvania, with headquarters at Richmond, Ind., who has been on leave of absence since April, 1929, died on August 2 at his home in Richmond at the age of 49 years. Mr. Wolfe was the inventor of the Wolfe tie tamper.

M. C. Byers, president and chairman of the board of directors of the Western Maryland and formerly chief engineer of the St. Louis-San Francisco, was shot and killed on September 23 by another officer of the road, during an altercation over railway matters. Mr. Byers was born on February 2, 1878, and was educated at the University of Pittsburgh. He commenced his railway service in March, 1897, as an assistant on the engineer corps of the Chicago division of the Pennsylvania, in which position he served on various divisions until November, 1900, when he was promoted to assistant engineer on the Marietta division. He was later transferred to the Indianapolis division and in December, 1902, he was appointed an assistant engineer maintenance of way on the Baltimore & Ohio, being appointed division engineer of the Baltimore division in August, 1903. A year later, Mr. Byers went with the Frisco as assistant engineer maintenance of way and in June, 1905, he was appointed assistant to the general manager. In January, 1906, he was appointed engineer maintenance of way and from January, 1909, until January, 1910, he was chief engineer, being on the latter date appointed chief engineer-operation. Mr. Byers left the Frisco on March 1, 1913, to become assistant to the president of the Great Northern, leaving this road in March, 1914, to go with the Western Maryland as assistant to the president. During federal control of the railways, he served as general manager of this road, the Cumberland Valley and the Cumberland & Pennsylvania, being on March 1, 1920, appointed president of the Western Maryland. In January, 1926, Mr. Byers was also elected chairman of the board of directors, serving in this position and as president until his death.

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CALCIUM CHLORATE

Now is the Time to Kill Weeds

1—Clean Up For Fall Inspection

2—Prevent Weed Growth Next Spring

Use the KNAPSACK DUSTER

Don't let that Weed Patch Spread!

WEED KILLER applications made during the Fall give most complete results not only in killing vegetation and improving the immediate appearance of the track, but also in preventing the growth of vegetation the following Spring.

With the Knapsack Duster one man can apply powdered Atlacide Calcium Chlorate and kill out the scattered patches of weeds that will otherwise spread.

The initial cost is low and the results are great, so that this is a particularly desirable outfit when forces are reduced and economy is being preached.

The Knapsack Duster weighs only sixteen pounds empty and carries twenty-five pounds of Atlacide. It does the work of a sprayer containing two hundred and twenty pounds of liquid weed killer solution.

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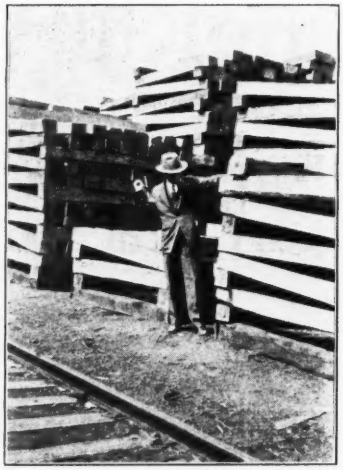

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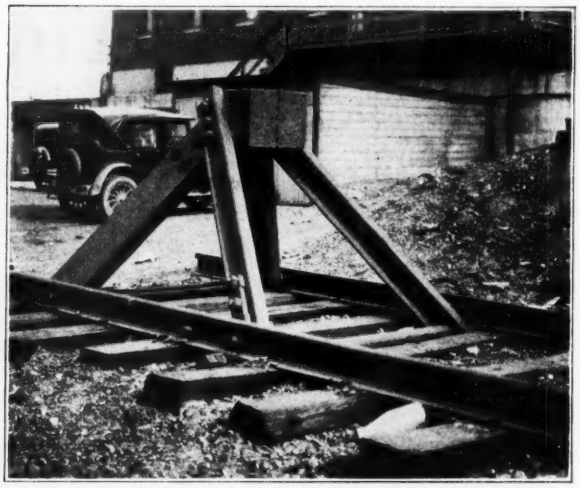
PLACE DURABLES WHERE CARS *MUST NOT* PASS!



The DURABLE MODEL B

DURABLES MECHANICAL

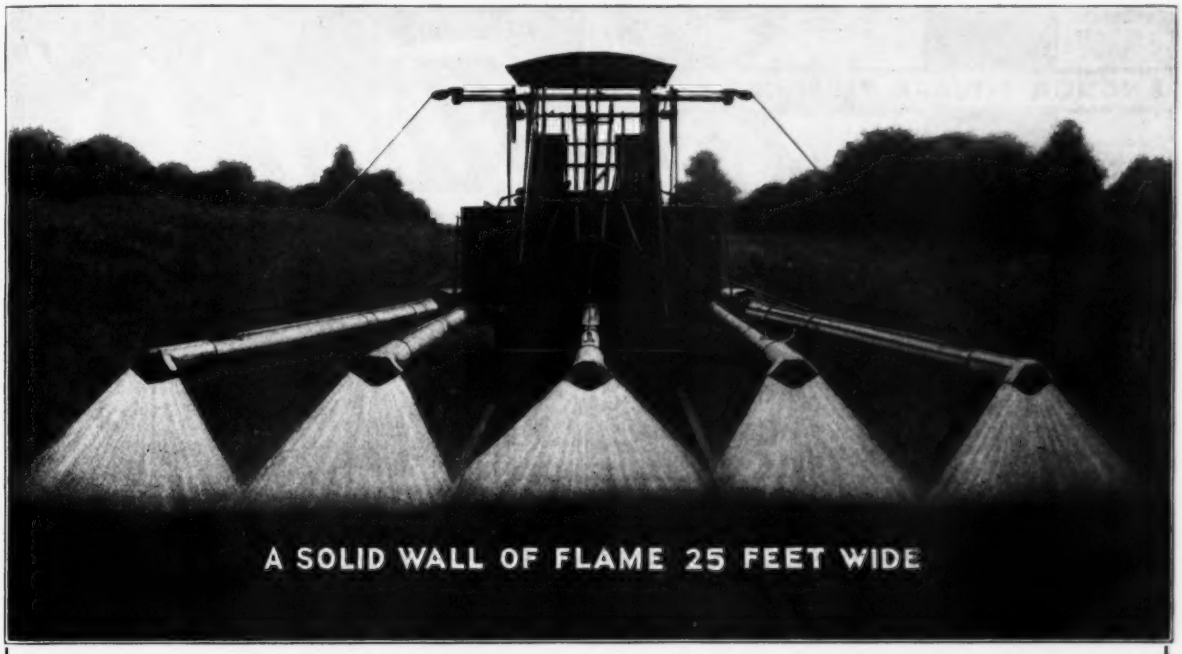
BUMPING POST

The DURABLE Bumping Post **stops the cars** —that's why only a DURABLE will do to protect a track end where an over-run car may fall into a river or off an elevation—or maybe crash through a building wall, or otherwise endanger human life.

In fact, you ought to have dependable DURABLE Bumping Post protection at ALL track ends—because the expense of getting any over-run car back on the track is usually several times the amount of any "saving" you can effect by accepting less reliable protection.

Guard your track ends with the Bumping Post that can always be depended on to **stop the cars** —the DURABLE.

Mechanical Manufacturing Company
Union Stock Yards, Chicago, Ill.



The Woolery New Model 5-Burner

GIANT "OCTOPUS"

Control Type **Railway Weed Burner** *Also Made in 3-Burner Type*

The Monarch of the Rails!

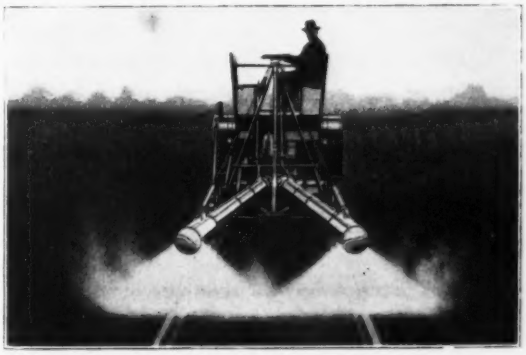
The Giant Octopus, the New Model Control Type Railway Weed Burner has been designed to meet every requirement for the complete and economical destruction of weeds on the right-of-ways of all railroads. It is the most versatile, the most efficient and the most dependable railway weed burner yet produced, while its cost of operation is low—but a small fraction of other methods of weed destruction.

Be "Woolery Wise"—Investigate this wonderful machine that will surely solve the weed problem on your railroad. Officials who have not attended a demonstration of this machine will find it to their economical advantage to arrange for a special demonstration on their own roads.

Perfect Control and Flexibility. Not content with the destruction of all vegetation on ballast, like an Octopus the long side arms of the 3-burner type can be swung out to burn weeds to a full width of 30 feet, while with the 5-burner type the long arms can be swung out to burn weeds to a width of 35 feet. Burners may be swung in or out—up or down—at the will of the operator at the control crank while the machine is in operation. Flames may be directed down the side of embankments or into the ditches, up the edges of cuts, or swung around the base of platforms, crossing fences, buildings, etc.

Burns Weeds in Ditches, Too!

Railroads with clean ballast can shut off the middle burners and by swinging the long side arms out project the fire into the ditches without fear of trouble from obstructions or uneven ground. Weeds, leaves and rubbish that clog the ditches and catch wash-down soil may now be burned out, which means less water soaked up by roadbed, less track heaving from frost, less shimming and tamping expense, and smoother, safer roadbeds at less cost the year around. A demonstration on **your** road will prove this, and result in the saving of thousands of dollars annually that is now being wasted by hand labor.



WOOLERY 2-BURNER MIDGET "OCTOPUS"

The Chore Boy of the Rails. Specially adapted for short line railroads, street car companies, lumber companies, etc. Presents a solid wall of flame 10 feet wide or its long arms can be set to burn to a width of 18 feet.

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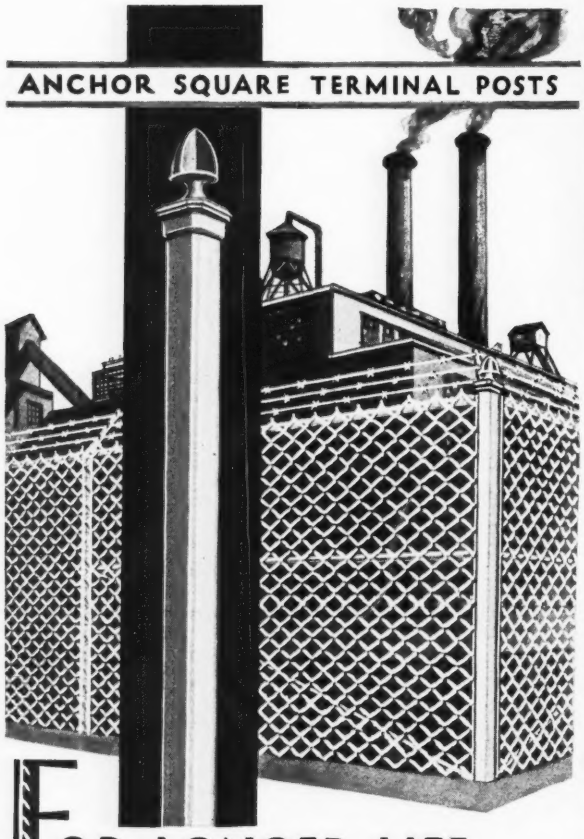
ANCHOR SQUARE TERMINAL POSTS



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GREATER PROTECTION
AND ADDED BEAUTY

Anchor Terminal Posts are stronger because of their square shape. Better looking—due to their graceful lines unmarred by disfiguring fabric holding bands. More unclimbable—because they offer no footholds. And lastly, more enduring because of their exceptional strength and heavy coating of galvanizing.

The Anchor Square Terminal Post is only another reason why Anchor Fences provide lasting protection.

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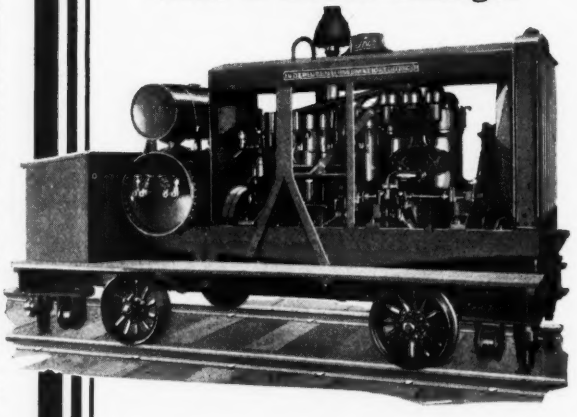
Thor "6"
AIR COMPRESSORS

The Only Compressor with a Super-Charger



Years of steady, reliable service have convinced users that the THOR Compressor DOES DELIVER more air—DOES OPERATE more tools—and DOES REDUCE maintenance costs. These important savings are made possible because of two exclusive features—the UNIT TYPE OF CONSTRUCTION and THE SUPER-CHARGER.

The SUPER-CHARGER enables the THOR to deliver 26% more air than any other compressor of the same size. This is the reason why you can run more tools from a THOR and complete the job in shorter time.

The UNIT TYPE OF CONSTRUCTION enables the THOR to eliminate bulkiness and trouble and reduce maintenance cost. Both engine and compressor are mounted on one crank case, doing away with clutches, couplings and gears. A deep section type steel frame provides a rigid foundation, minimizing vibration and distortion.

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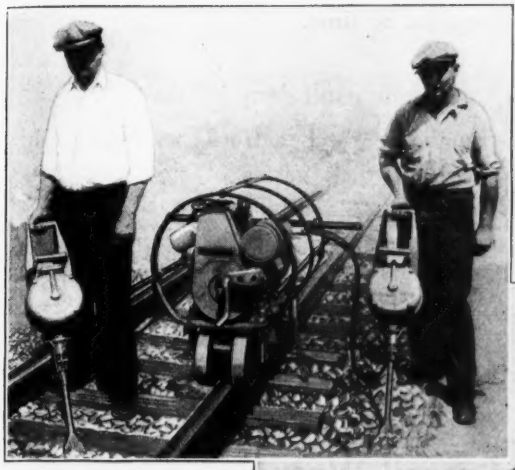
for small section gangs. For spotting, bringing up swinging ties, surfacing and routine track maintenance. 400 to 600 feet per day can be covered with two trackmen and foreman.



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Model H-2 Power Unit. Easily handled by two men. Consists of generator directly connected to air-cooled engine of ample power to operate two Jackson Hammer Blow or Universal Tampers. Weight of this unit is 375 pounds.

To meet the need of small mechanical tamping equipment, small section gangs may now be equipped with a power unit which can be rolled along the rail by one man. Two men are needed, however, to lift it clear of the track. This small unit will operate two tampers and inasmuch as 250 feet of line cable is furnished, 500 feet of track can be worked without moving the machine.

Write us for full description of our various units and equipment or let us show you what our full line is capable of doing.

Upper Right:

Model H-2 Power Unit is easily handled, only one man needed to roll along the rail. Output of this gas-electric unit is 1 K.V.A. in 110-volt, 3 phase, 60 cycle current. Low gasoline consumption.

To Right:

View showing Jackson 8-Tamper Hammer Blow Plant in operation. Plants are available in two, four and eight tool units to meet any requirement of speed or gang organization.

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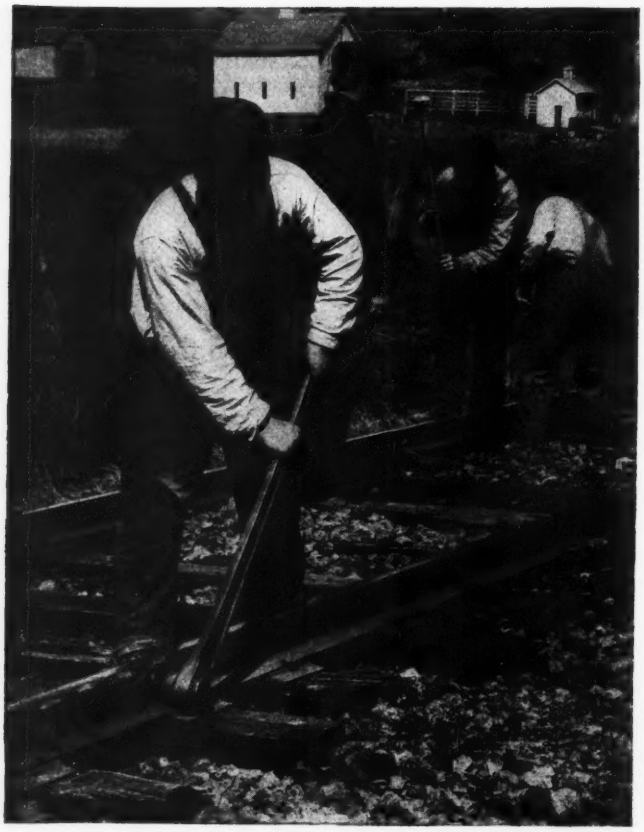

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a reversible ratchet track wrench could help your track gangs in speeding their track bolting—safely.

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It does its work speedily, satisfactorily, savingly. Two types—P.2., grinds opposite rails simultaneously. P.3., grinds one rail at a time.

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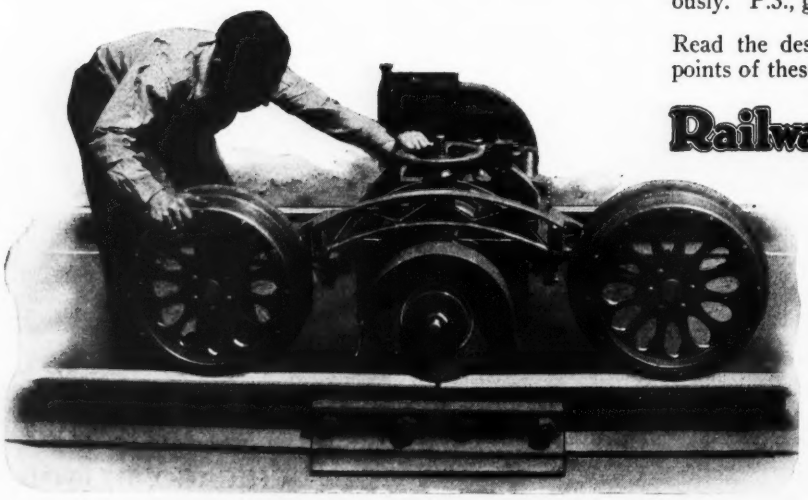

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Framing of Timbers "BEFORE" Treatment Is Essential

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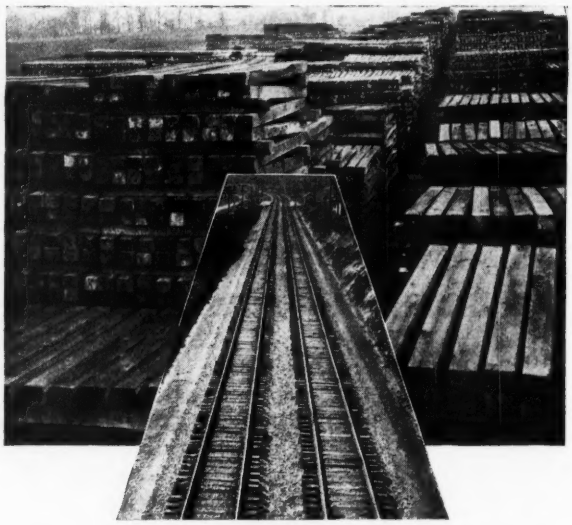

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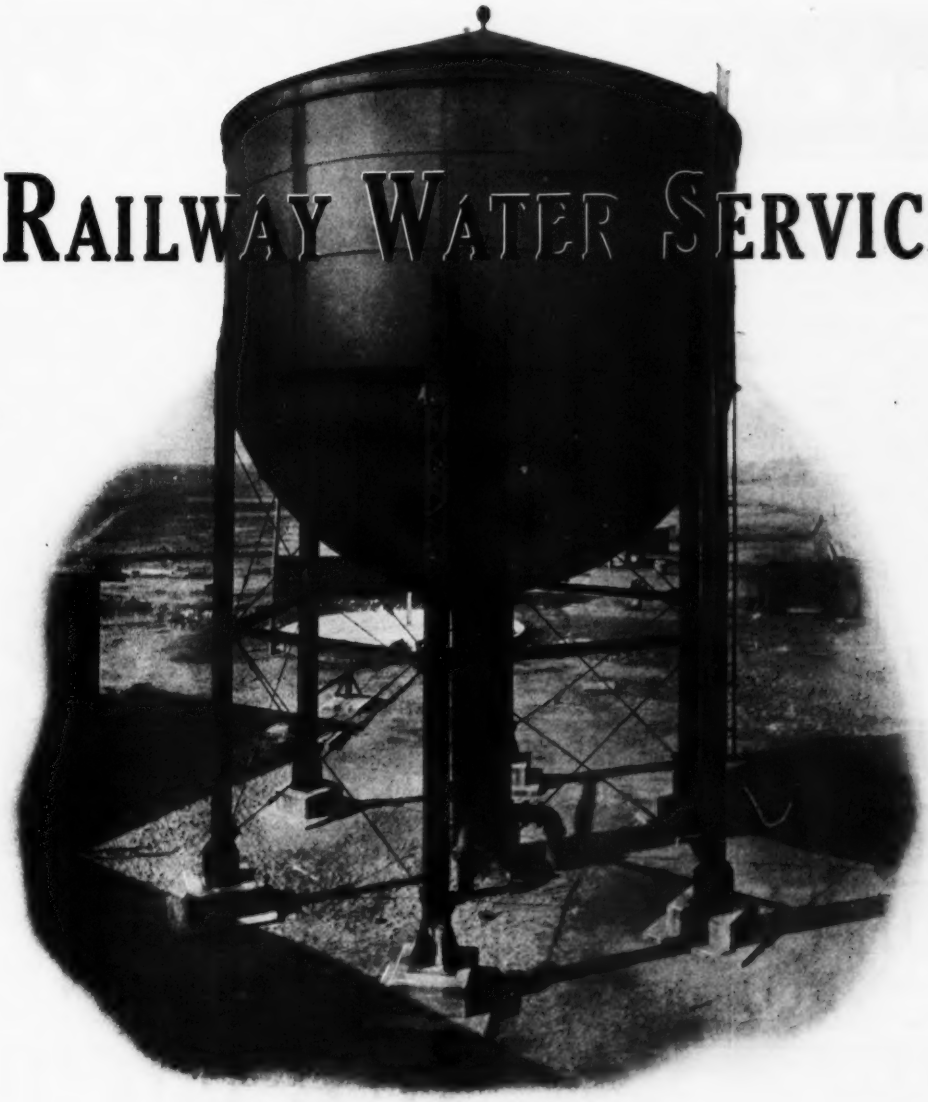

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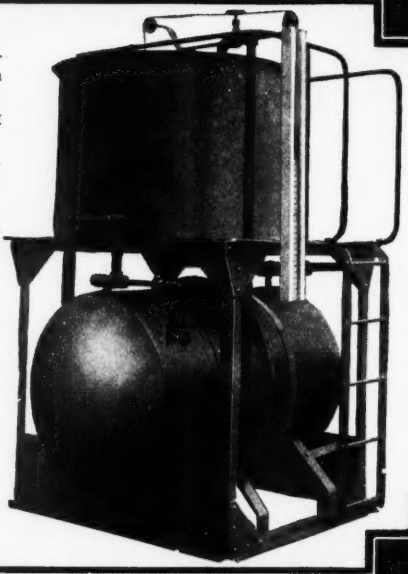

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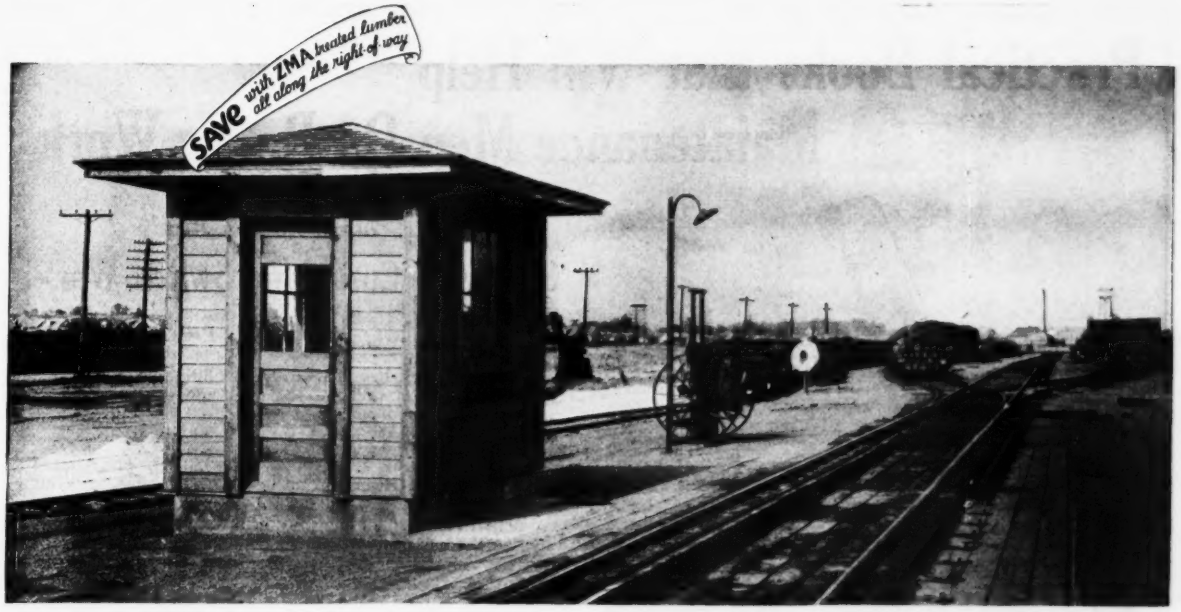

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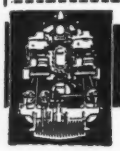

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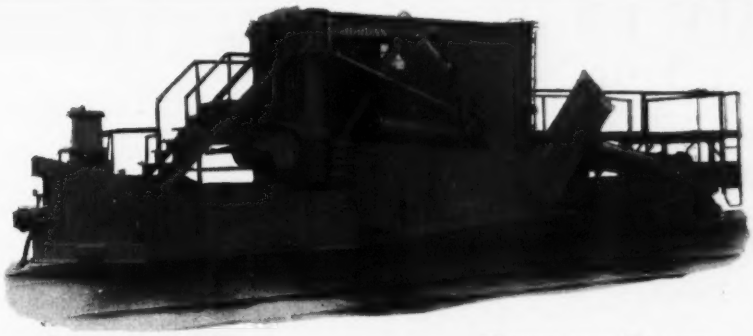

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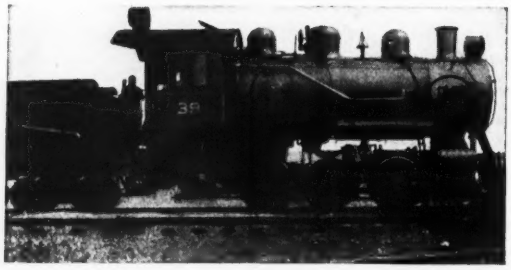

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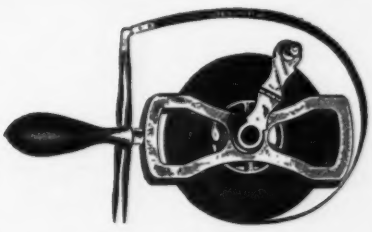

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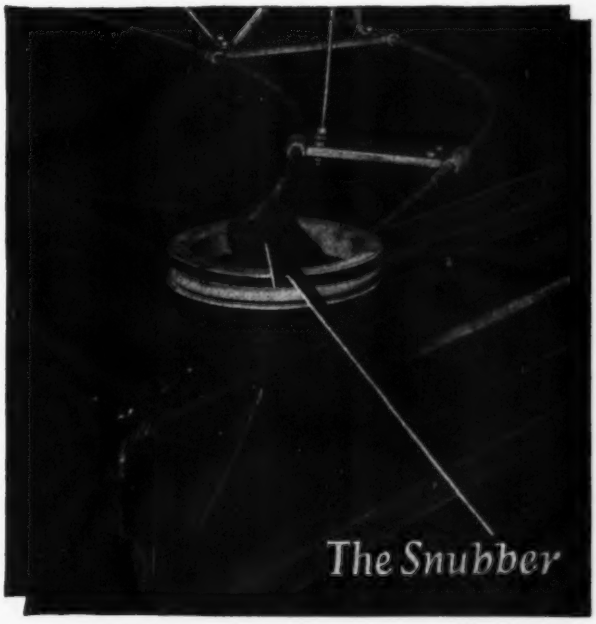
YIELDS...
The vehicle
STOPS...
Lives are
SAVED...



When The HIGHWAY GUARDIAN protects a crossing!

GRADE crossing safety such as THE HIGHWAY GUARDIAN provides became practical when a yielding snubber was perfected. As a train approaches, a protecting barrier starts to lower. In a few seconds it places a barricade of steel across the highway, its outer end locking over the engaging post of a powerful snubber.

An on-coming motorist, disregarding warnings crashes into the barrier. Instead of crashing through it, a wire rope of great strength engages the front of the car. The force of the impact is transmitted to the snubber which immediately softens the blow. It yields, the vehicle continues forward a few feet, but gradually and positively the snubber overcomes all forward movement and brings the vehicle and passengers safely to a stop. With the danger passed, the barrier automatically rises allowing traffic to proceed. The snubber, returned by hydraulic pressure to its starting position, is ready for the next irresponsible driver.

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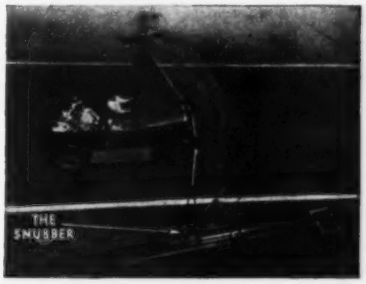
How THE HIGHWAY GUARDIAN operates is interestingly told in Bulletin No. 750. Write for a copy.

At the moment of contact with the barrier the wire rope gives an even bearing against the car. The snubber has not started to act.



Compare the position of the snubber in this picture with its position in the illustration above. Here the snubber has moved to take up the shock.

The fundamental idea from which THE HIGHWAY GUARDIAN has been developed was the ingenious conception of Mr. Joseph Strauss, eminent consulting engineer and builder of many of the world's famous bridges

Franklin Railway Supply Company, Inc.

New York Chicago St. Louis San Francisco Montreal

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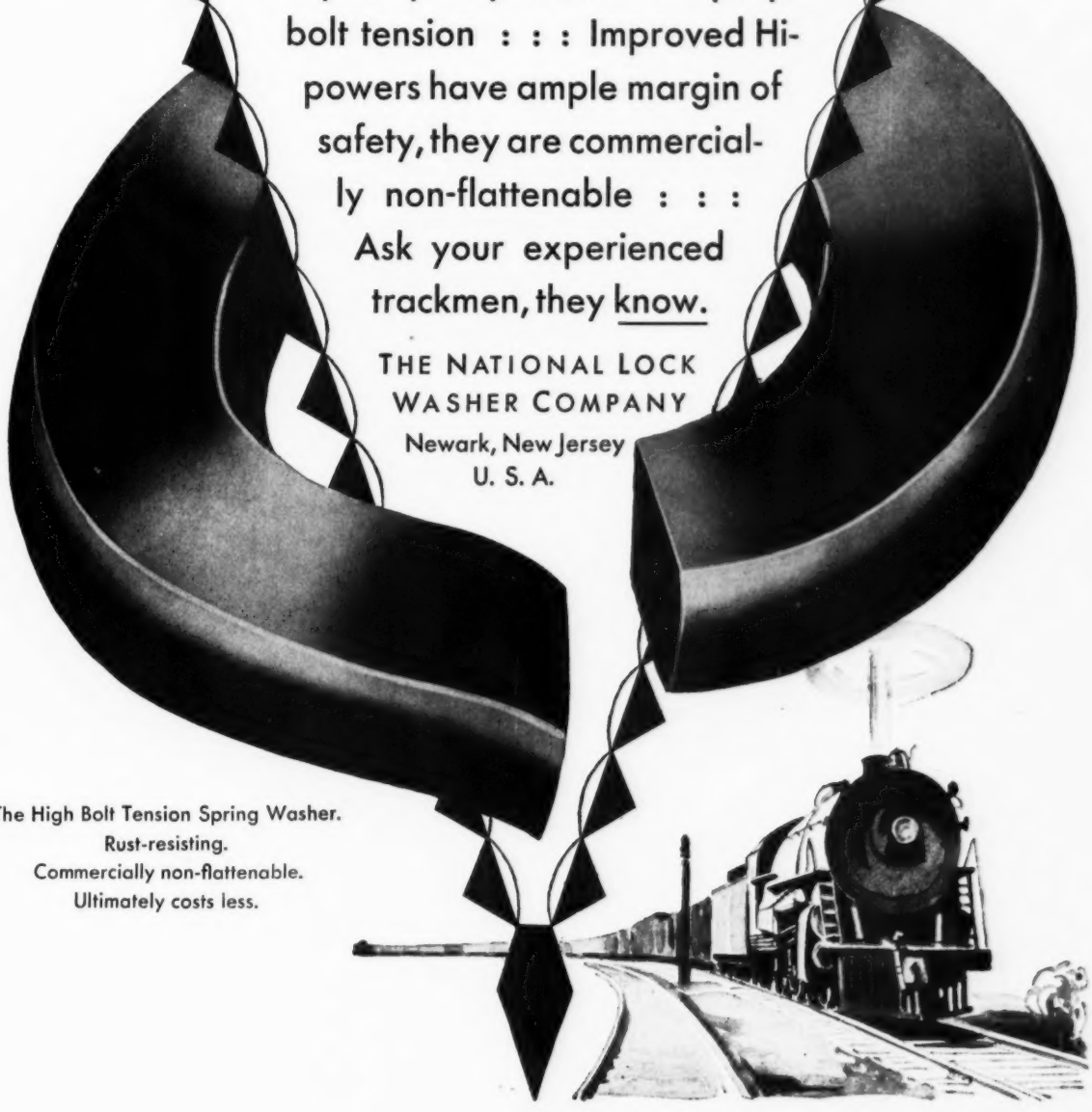
IMPROVED HIPOWER

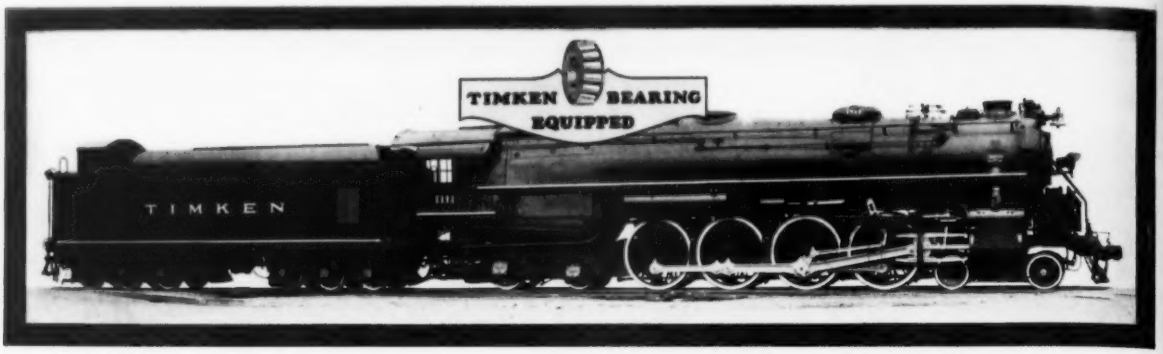
MARGIN OF SAFETY

In spite of instructions to the contrary, trackmen sometimes use pipe extensions on wrenches when tightening bolts, and frequently they exceed the proper bolt tension : : : Improved Hipowers have ample margin of safety, they are commercially non-flattenable : : : Ask your experienced trackmen, they know.

THE NATIONAL LOCK WASHER COMPANY
Newark, New Jersey
U. S. A.



The High Bolt Tension Spring Washer.
Rust-resisting.
Commercially non-flattenable.
Ultimately costs less.



Another Tough Railroad Job For Timken Bearings

—but Timkens will lick it, just as they have licked Industry's toughest jobs in all kinds of machinery, and in section cars, inspection cars, crossing gates, freight cars, passenger cars and other railroad equipment.

For the first time in the history of railroading, a locomotive has been placed on a full anti-friction basis, and Timken is proud to have the privilege of pioneering this great forward step in the interests of American railroad advancement.

The Timken locomotive, pictured above, was designed and built for the sole purpose of demonstrating the advantages of roller bearings as applied to motive power.

It has been placed in service on a strictly non-revenue basis, and will be loaned without charge to railroad companies desiring to determine its operating characteristics under their own conditions.

Every wheel turns on Timken Tapered Roller Bearings—front truck wheels, driving wheels, trailer truck wheels and tender truck wheels.

There are 32 Timken Bearings in the wheels and booster, and in addition, Timkens are used in the speed driver of the valve pilot and in the train control governor.

Another revolutionary feature of this locomotive made possible by the higher rotative driving wheel speeds secured through the use of Timken Bearings, is the fact that it can handle fast freight and passenger trains with equal efficiency, having the necessary power and speed for both purposes.

It is confidently expected to duplicate the operating and maintenance economies that have been shown by Timken Bearings in all types of railroad rolling stock and maintenance equipment. The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN *Tapered Roller* **BEARINGS**